Jijamata Mahavidyalaya, Buldhana

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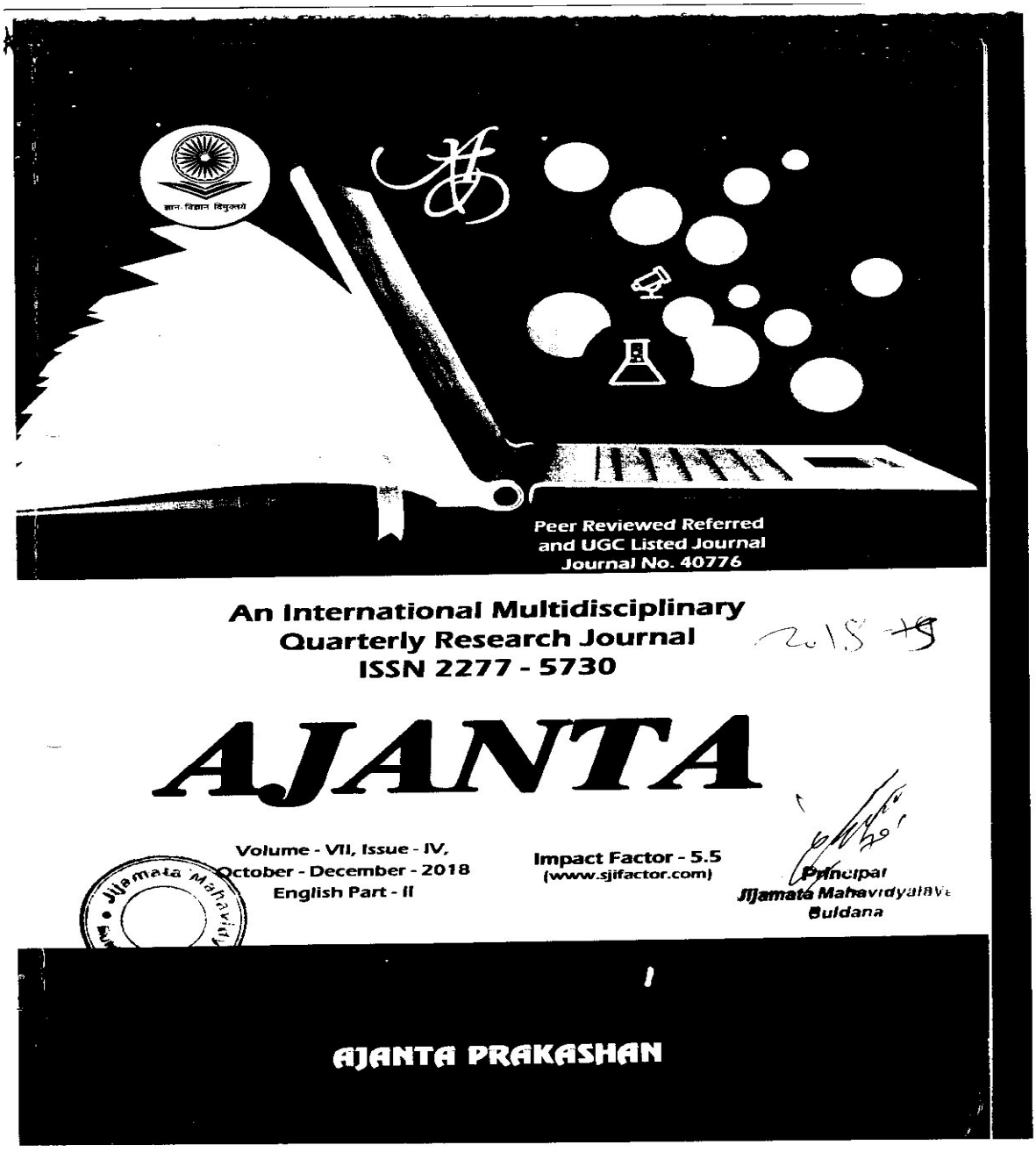

CONTENTS OF ENGLISH PART - II

14. Petrol Price Hike and its Effects

Prof. Suresh N. Gawai
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Introduction

Petrol has become an indispensable part of our day-to-day life, and we can't imagine our life without it. But the petrol prices are sky rocketing, and it is eventually going to affect each and everything that we use in our day to day life. Poor people are already working hard to earn square meal a day and this hike is definitely going to paralyze these already-burdened people. Within three years petrol price has increased 10 times and is still increasing. It is nothing but adding fuel to the fire. Petrol hike directly or indirectly affects all the major sectors like transportation, textiles, auto, FMCG etc, for manufacturing & transportation. This affects the prices of daily essential commodities which are transported on a daily basis. Banking sector is also expected to suffer due to high inflation level.

Increase in fuel price will also increase in food price. This will have a more severe impact on poor people because poor households spend more than half of their income on food and only a tenth on fuel. It is a chain reaction once started will affect all. Increase in petrol price will increase the transportation cost, increase in transportation cost will increase in price of goods, and this increase in price of goods would gradually force the people to loosen their pockets even more, and so on like this, the chain will further propagate. These ups and downs push more people into poverty and leading to a more pathetic situation of those already poor. This has obviously sent shock waves to the common man who is trying hard to make both ends meet. Price hike affects only the low wages or fixed salaried middle class families as compared to higher wages salaried class. The existing middle class is squeezed and many of those striving to attain the middle-class standard find it persistently out of remit will bring no negative impact on government employees as their DAs will be increase accordingly. Rich and corrupted people are least bothered of it. Business class like auto-rickshaw drivers shall transfer the burden to common people so they are also safe. Common people if doing business shall also pass the burden to customers and chain reactions. The community that suffers the most is the common people or "aam aadmi".

So what are we thinking? For the situation to get worse or are we waiting for such a heroic person who'll bring us out of this situation. No, we, the people are the one to do something and control the situation. Stop blaming government and think how to solve it. We Indians import oil from different countries. We don't have enough oil to meet our requirements. So we have to depend on import of oil. If there is increase in international price then we have to bear price hike in India also. Then value of rupee in comparison with dollar is becoming weaker in international market. Increase in number of vehicles also causes hike in petrol prices. So the thing we can do is to reduce oil consumption by using public transport for travelling to routine places like our office, markets etc. Use of high capacity transport system like train, ships instead of trucks and carrier vans. Use of cycles to go to nearby places instead of bikes or cars. Cutting off fuel supply or switching the engine off when traffic is halted for long. Developing alternate sources of energy like solar energy etc. Development of bio-diesel, and government should allocate more funds for developing alternate sources of energy as well as develop high capacity goods and public transport system. At last but not least I want to say petrol is a natural resource and limited in nature. We have to use it judiciously so that our future generations can also use it, and thus lead to sustainable development. As someone has rightly said,

The impact of rising oil prices on Indian economy

Higher crude oil prices will adversely impact the twin deficits of current account and fiscal, which will have spillover effects on monetary policy, consumption and investment

India, the world's seventh-largest economy, was a key beneficiary of falling crude oil prices between 2013 and 2015. An analysis by this newspaper, more than a year ago, had indicated that almost the entire reduction of about 0.6% of the gross domestic product (GDP) in India's fiscal deficit between FY14 and FY16 could be attributed to the sharp fall in crude prices. Lower crude prices also contributed to the narrower current account deficit. The biggest benefit of the fall in oil prices was evident in narrower twin deficits. Since the pass-through of the fall in crude prices to retail consumers was limited (the government retained a large part of the benefits by hiking excise duty on retail fuel products), the direct impact on inflation—measured by consumer price index (CPI)—was muted.

Things, however, started reversing about two years ago and have gathered pace in the past few months. As against an average price of $46.2/barrel for the Indian basket of crude oil in FY16, it rose to $56.4/barrel in FY18 and averaged $65/barrel in the fourth quarter of FY18.

With the US' decision to walk away from the Iran nuclear deal and to re-impose sanctions on Iran, upside risks to crude prices cannot be ruled out. It is then worth understanding the impact of higher crude prices on the Indian economy.

In short, one could safely conclude that higher crude prices will adversely affect the twin deficits—fiscal and current account deficit—of the economy, which will have spillover impact on the monetary policy, and consumption and investment behaviour in the economy. However, before we talk about the impact in numbers, it is important to address one tricky question: "what is driving higher crude prices?"

The question is relevant because the factors leading to change in prices will decide the sustainability of the higher prices.

If the rise can be attributed to demand-side factors, it is not necessarily adverse for economic activity or financial markets. The higher crude oil imports bill could be offset by higher oil and non-oil exports (and of course, remittances). Similarly, better domestic economic activity could help meet fiscal deficit targets. However, if oil prices are pushed up by supply factors, it would be concerning.

According to the recent World Economic Outlook (WEO) by the International Monetary Fund (IMF), roughly 80% of the recent oil price increase was caused by deterioration in supply conditions (particularly faster-than-expected deterioration in Venezuelan output). This, however, is not the only study on the factors leading to higher crude prices. The "Oil Price Dynamics" report published by the Federal Reserve Bank of New York finds that less than two-fifth of the rise in oil prices since the beginning of 2018 was on account of supply-side factors. These contrasting studies lead to uncertainty regarding the sustainability of higher crude prices.

Not surprisingly then, the majority of the forecasts for oil price remain at $65-70/barrel. An increase of 15-25% in oil prices in one year will impact the Indian economy in various ways.

Four ways in which diesel, petrol price rise will impact you

Rising petrol and diesel prices can dent your savings by adding to your monthly budget for not only fuel but also essential commodities and other goods

Crude oil prices have crossed the $80 per barrel mark as on May 17, the highest since November 2014, and up from $50 in June 2017. Not surprisingly, since June 2017, prices of fuel like petrol and diesel, that are directly linked to crude oil prices, are being revised on a daily

basis. While there was a pause in these revisions during the recent assembly elections in Karnataka, they have resumed thereafter.

With the daily revision in prices, you might not always notice that your monthly fuel outgo is on the rise. But over time, this could dent your budget by not only increasing your outgo for fuel but also essential commodities and other goods, apart from making foreign trips and loans costlier. Here are four things which can become costlier for you.

Fuel bills

A direct impact of rising diesel and petrol prices is increase in what you spend on fuel every month for the same amount of travel. Back-of-the-envelope calculations show that a person driving 900 km a month in Mumbai could see her monthly fuel bills in May 2018 go up by about Rs1,250 for a petrol car and Rs1,000 for a diesel car, compared to May 2016. Delhi commuters too take a hit.

Unfortunately, this is a cost you can't do much about. "If a person is accustomed to travelling to office by car, just because her monthly bill has gone up by Rs2,000, this person is not going to switch to public transport. The only thing that can be reduced is weekend driving to some extent," said Suresh Sadagopan, certified financial planner and founder of Ladder 7 Financial Advisory.

Madan Sabnavis, chief economist at CARE Ratings, said high fuel prices over a prolonged period may force households to reallocate resources. "If I have to increase a certain amount on fuel, then either I will be saving less or I will have to cut down on other expenses. So if the higher prices remain for a long time, it could affect demand for other products or reduce savings," he said.

Essential commodities and goods

Record high prices for diesel means that the cost of transporting goods goes up across the country. In turn, prices of essential commodities like fruit and vegetables as well as other goods increases.

"If the higher price lasts long then it will have an inflationary effect. They can absorb it to some extent but cannot be doing it constantly. This time, petrol and diesel prices have risen quite a bit at the consumer level," said Crisil chief economist Dharmakirti Joshi.

Foreign travel, education, trade

This is another indirect impact arising out of high crude oil prices. "As crude oil prices go up, automatically we see pressure on the external account and the (cost of) imports go up, deficit increases and the rupee comes under pressure. So if someone is planning a holiday or planning to study outside India, the depreciating exchange rate will start showing effect. We have had a strong exchange rate so far but it started depreciating since oil prices started going up," Sabnavis said.

This will also impact those with a business that has dealings in foreign currency.

It's better to get ready for the impact and rejig your finances as the government has limited options to prevent retail fuel prices from going up if crude oil prices are on the rise or the rupee continues to depreciate.

6 effects of rising crude oil prices on the Indian economy

Why is everyone so concerned about crude oil prices all of a sudden? That's because the global crude oil prices have been steadily rising over the past few months. For the first time since 2014, the international benchmark for global oil prices crossed the $80/barrel mark in May 2018. Compare this to the $29/barrel price during early 2016! This sudden surge in prices has a great impact on various segments of the Indian economy. Let's have a look:

Higher prices: adverse impact on fiscal deficit

India imports 1.5 billion barrels of crude oil each year . This comes up to around 86% of its annual crude oil requirement. So, the surge in crude oil prices could increase India's expenditure, thus adversely affecting India's fiscal deficit - the difference between the government's total revenue and total expenditure. Fiscal deficit indicates the amount of money the government has to borrow to meet its expenses. A rise in fiscal deficit could negatively affect the economy as well as markets. The fall in crude oil prices was a major contributing factor in the reduction of India's fiscal deficit between 2014 and 2016, according to a report by Livemint . A few years back, we explained the impact of a falling crude oil price on fiscal deficit. To know more, click here.

Impact on the rupee

The rise in crude oil prices has a clear impact on the Indian rupee. On 24 May 2018, the rupee closed at 68.34 against the US dollar. This is a near 18-month low for the rupee, and only 0.6% away from its all-time low of 68.825, according to a Livemint report . In addition, if crude

oil prices remain at these high levels, the rupee is further expected to depreciate by the year end. Rupee depreciation has a reverberating effect on the Indian economy and even the stock market. To arrest the rupee's fall, the RBI often takes a few steps. Here's a look at how the RBI defends the falling rupee.

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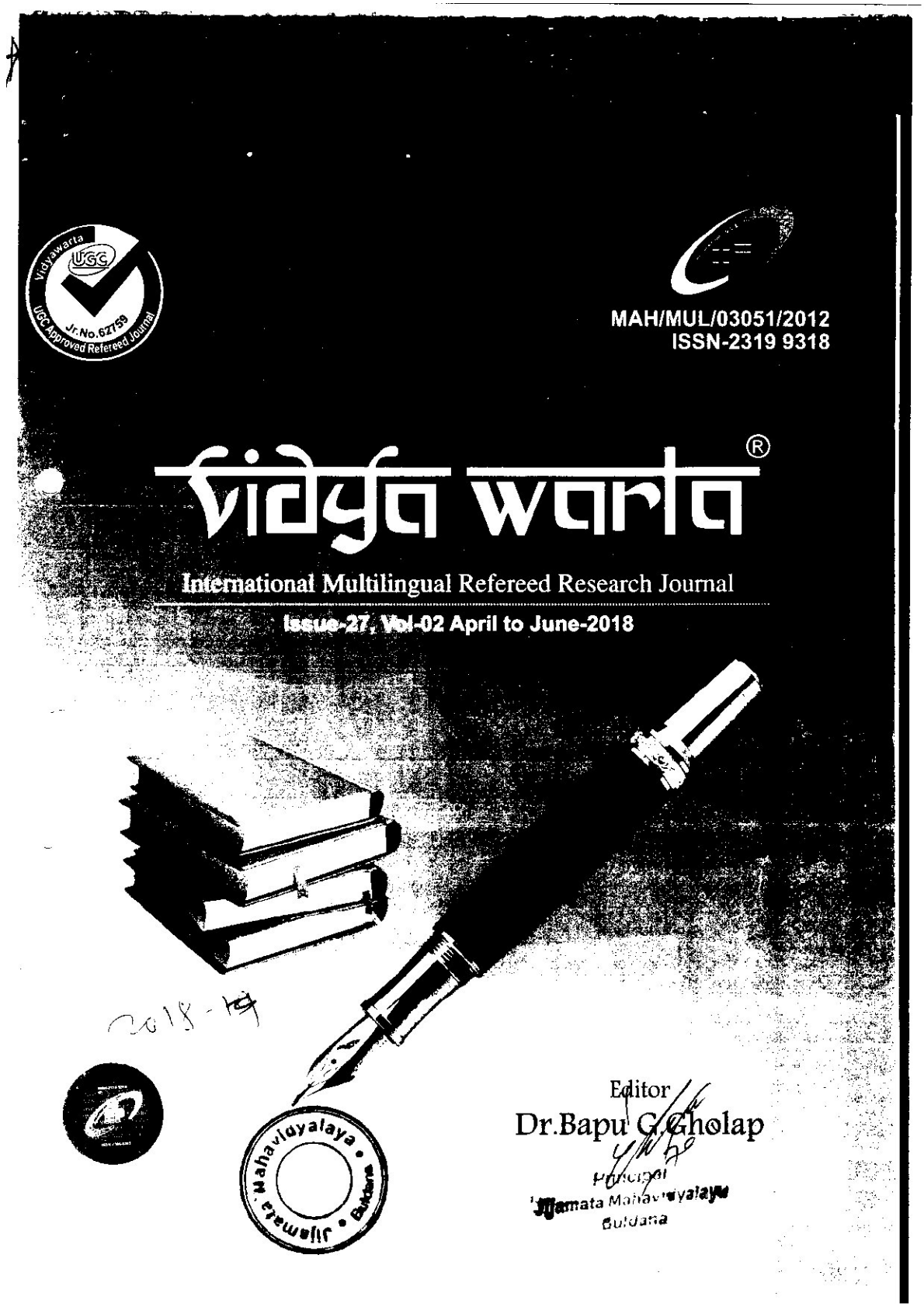
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financial inclusion is governed by sustainability and commercial viability of transactions and not merely on exemptions , subsidies and incentives. Therefore, there is a need of the hour to develop customized reengineered innovative products specifically designed to the lifestyle pattern and income levels in the rural sector.

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05

DEMONETIZATION IMPACT ON DOMESTIC REMITTANCE

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Domestic Remittance Market:

The domestic remittance market is growing at a faster pace with the help of organised money transfer channels, mobile money transfer and business correspondents (BCs) of banks. Nearly 100 million migrants have travelled to Tier-I cities in search of jobs. This results in the overall domestic remittance market growing at an average rate of 10.3 per cent during 2007-13. Remittances from migrant workers contribute more than 50 per cent to the overall domestic remittances market. Traditionally, a migrant worker can transfer money by visiting a post office, or depositing the money in bank branches, or handing over the money to friends/families who are travelling back home. At present, migrant labours prefer to send money through instant money transfer products compared to the bank route, NEFT (National Electronic Funds Transfer), because of the efficiency and convenience the products offer. Through these channels, a migrant labour can make transactions at his convenience at an agent located near his home. The Domestic Money Transfer is a service launched by the Reserve Bank of India. The RBI allows banks to create their own merchant outlets or enable their partner company's merchants to facilitate general public with money transfer service. The service offers to transfer or deposit money in bank accounts by simply visiting the local mobile shop, kirana

stores, and chemist outlets etc. These merchants are registered either with a master bank correspondent or prepaid instrument issuer company. Customers can deposit or transfer Rs. 25000 in a month to their own or others accounts. This service is widely used by the migrants working in the metro cities and those who send money to their families and businesses on regular basis. The service felicitates the customers and eases the banks in terms of managing their customers in the decentralized way and giving the liberty to perform transactions even after "bank timings".

Benefits of Domestic Remittances

• Increased domestic remittances have a positive impact on the nation's economic growth.

• Domestic remittances also eliminate difficulties associated with credit rationing.

• These remittances finance needs for consumption or capital expenditures.

• On a macroeconomic level, raising the total capacity of financing of investments through domestic remittances will improve the local economic situation.

• Domestic remittances can also provide support in counter-cyclic conditions when when local market situations are not favourable.

Demonetisation and Domestic Remittance Market

On 8 November 2016, the Government of India announced the demonetisation of all Rs.500 and Rs.1,000 banknotes of the Mahatma Gandhi Series. The government claimed that the action would curtail the shadow economy and crack down on the use of illicit and counterfeit cash to fund illegal activity and terrorism. The sudden nature of the announcement and the prolonged cash shortages in the weeks that followed created significant disruption through out the economy, threatening economic output. The Specified Bank Notes (Cessation of Liabilities) Ordinance, 2016 was issued by the Government of India on 28 December 2016, ceasing the liability of the government for the banned bank notes. This has impacted the firms associated with movement of domestic remittances.

Effects of demonetization on remittance business:

• Firms related to remittance movement have a Prepaid Payments Instruments (PPI) licence from the Reserve Bank of India (RBI) and act as business correspondents (BCs) for banks.

• They set up their "money transfer counters" in kirana stores, medical shops, and mobile recharge outlets.

• Their software platforms and logistics systems for cash collection facilitate domestic remittances that are paid in the form of cash by the remitter and deposited in the bank account of the beneficiary.

• Operating with relaxed KYC (know your customer) norms, they channelize small-value remittances with a limit of Rs.5,000 per transaction and a monthly cap of Rs.25,000 per remitter.

• Thus, these firms belong to an intermediate zone between the fully cash-based courier system and the entirely digital systems of a bank-to-bank transfer or a mobile-wallet transaction.

• Before demonetisation, Rs.4,000 crore per month was remitted through this channel. After demonetization, a big drop in the business numbers has been recognized across the country. The current trend shows a downfall of 60% of total business.

• Shortfall of valid currency notes in the market has stopped remittance transactions.

• RBIs instructions to the industry of not accepting the Old Currency Notes.

• There could be some regular people enjoying the service to convert their illegal money into white. After demonetization, it has been stopped.

• Businesses with cash transactions are almost stopped; people are not paying each

others, not accepting payments.

• The number of "Wallet to bank transfer" transactions using multiple mobile apps has increased.

• Banks have started promoting UPI and other modes and mobilizing public to do fund transfer using their mobiles.

• To enjoy the high session, some wallet companies have waived off the transaction changes on money transfer.

• "Switching" charges are officially waived off.

Conclusion

The failure of incomes in the informal sector to recover to the levels they would have reached without demonetisation appears to be an important factor for the weakness in the business correspondents (BC) remittances market. Steps need to be taken to reduce the impact of demonetization on remittance sector.

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Title Key: Study β and A coefficient of some Heterocyclic ...

Study β and A coefficient of some Heterocyclic Drugs at 29°C in Methanol-Water and Acetone-Water mixtures Viscometrically

S.R.Ingale[1], S.S.Kotalwar[2] ,K.N.Sonune[2*] , R.D.Khalapure[2],B.Dhotre[3].

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Abstract:

The basic principle of viscosity measurement is to study the interactions between solute and solvent. The viscometric measurement of heterocyclic drugs viz 1,5 dihydro-4H-pyrazolol (3,4-d) pyramidin 4-one (Ligand-1) and 4-Hydroxy-3-[1(4-nitrophenyl)-3oxobutyl]-2H-chromen-2-one (Ligand-2) were carried out at various concentrations of solvents Methanol and Acetone at 29°C. The data obtained during this investigation were used for the characterization as Structure Formers or Structure Breakers.

Key words :- β - coefficient, viscometry , viscosities and Densities.

Introduction:

The refractive index is an important additive property of molecular structure of liquid. Every liquid offers some resistance to flow. This resistance to flow is called viscosity. It is developed in liquids because of sharing effect of moving one layer of liquid past another motion of liquid can be visualized as a movement of one layer over another. A layer move quickly then second and so on. This type of flow is called laminar flow or streamlined flow. Useful information about solute-solute and solute -solvent interaction provides when the behavior of electrolytes are studied by viscometry . Many workers [1-3] have been studied these interactions in aqueous and non - aqueous solutions.

Ikhe [4]has studied the viscosity of [HBMPPI] ,[AHBMPPP] , [PHNMPMPP] and captopril in 70% dioxane water mixture at different concentrations. Molecular interactions of electrolyte in binary mixture of two liquids in terms of viscosity , β - coefficient have been studied by Mehrotra et.al.[5], Das et.al.[6] , Nikam[7], Kalra et.al.[8] , Pandy et.al.[9] and Raut et.al.[10]. Gadpayle M.R.[11] have studied the β -

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coefficient value of some substituted chalcones in 70% DMF-water mixture while Tambatkar G.D.[12] have studied viscosity and β - coefficient value of some heterocyclic and non-heterocyclic drugs in 70 % Dioxane-water mixture solution. Sonar et.al.[13] have been studied on viscosity, density and refractive index of substituted heterocyclic compounds in different media. Tayade et.al.[14] have been studied viscometric study of s-substituted triazinothiocarbamides at 35°C in Dioxane-water mixture. Deosarkar et.al.[15] have been studied volumetric, viscometric and refracometric behavior of glycine+(aqueous isoniazid) ternary mixtures at 298.15°K.Recently Yasmin Akhtar[16] have been studied volumetric and viscometric studies of solute-solvent and solute-solute interactions of glycine in aqueous electrolytes at 30°C.

The present study deals with the study of molecular interactions in terms of viscosity, β-coefficient of different ligands in different concentrations of Methanol-water and Acetone-water mixtures in different concentrations.

Experimental:

The viscosities were measured by means of Ostwald's Viscometer (±0.11%$Kgm^{-1}s^{-1}$) which was kept in equilibrium with elite thermostatic water bath (± 0.1 °C) . Ligand solutions of different concentrations were prepared in 70 % Methanol -water and Acetone- water. The ligands used are $Ligand_1$- 1,5 dihydro-4H-pyrazolol (3,4-d) pyramidin 4-one $Ligand_2$- 4-Hydroxy-3-[1(4-nitrophenyl)-3oxobutyl]-2H-chromen-2-one.

The relative viscosity of each solution is determined by following empirical formula

$\eta_r = (ds \times ts) / (dw \times tw)$ ----------(1)

Where η_r = relative viscosity of ligand solution, ds = density of ligand solution ,dw=density of distilled water, ts=time of flow for solution, tw=time of flow for distilled water

The relative viscosity and density data for ternary mixture at different concentrations are presented in Tables 1 to 4.

The relative viscosities have been analyzed by Jones -Dole equation

$(\eta_r - 1) / \sqrt{c} = A + B \sqrt{c}$----------(2)

Where C =molar concentration of the ligand solution ,A=Falkenhagen coefficient, B=Jones-Dole coefficient A is the measure of solute - solute interactions and B is the measure of solute - solvent interaction.

The graphs are plotted between $(\eta_r - 1) / \sqrt{c}$ Vs. $\sqrt{c}$. The graph for each system gives linear straight line showing validity of Jones - Dole equation. The slope of straight line gives value of β-coefficient.

In the present study, relative viscosity of ligand solutions decreases with increase in the concentration of ligand may be attributed to increase in solute - solvent interactions. From the graph of $(\eta_r - 1) / \sqrt{c}$ versus $\sqrt{c}$, 'A' which is the measure of solute - solute

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interactions and 'B' which is the measure of solute - solvent interactions has been calculated .

Result and discussion:

The large and small values of 'A' show the stranger and weaker solute - solute interactions respectively as listed in tables 5 and 6 .

Solutes with positive viscosity β-coefficient are characterized as "Structure formers" and will impose a new order by reorientation of the adjacent water molecules indicating strong solute- solvent interactions.

Solutes with negative viscosity β- coefficient is characterized as "Structure Breakers" indicating weak solute - solvent interactions.

Here I was found that both Ligands in Methanol system and Acetone system shows positive value i.e. Structure forming activity and no one shows Structure Breaking activity. Such type of results is also shown by Pandey et al[13].

Observations and Calculations:

Table -1
Densities and viscosities of systems in Methanol-Water at 29°C(±0.1°C)
System: Ligand -L_1

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.902	63	1.5001	7.0736
2	40 x 10^{-4}	6.3246	0.932	58	1.4269	6.7706
3	30 x 10^{-4}	5.4772	0.947	56	1.3999	7.2974
4	20 x 10^{-4}	4.4721	0.954	51	1.3999	8.9463
5	10 x 10^{-4}	3.623	0.961	44	1.1162	3.6772

Table -2
Densities and viscosities of systems in Methanol-Water at 29°C(±0.1°C)
System: Ligand -L_2

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.902	64	1.4475	6.3296
2	40 x 10^{-4}	6.3246	0.932	57	1.3321	5.2547
3	30 x 10^{-4}	5.4772	0.947	53	1.2586	4.7190
4	20 x 10^{-4}	4.4721	0.954	49	1.1722	3.8523

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5	10×10^{-4}	3.1623	0.961	44	1.0603	1.9082

Table -3 Densities and viscosities of systems in Acetone-Water at 29°C(±0.1°C)
System: Ligand -L_1

Sr. No.	Concentration C (mole/liter)	$\sqrt{c} \times 10^{-2}$ (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50×10^{-4}	7.0711	0.906	53	1.2676	3.7850
2	40×10^{-4}	6.3246	0.937	54	1.3357	5.3117
3	30×10^{-4}	5.4772	0.951	53	1.3305	6.0310
4	20×10^{-4}	4.4721	0.959	49	1.2404	5.3781
5	10×10^{-4}	3.1623	0.963	44	1.1185	3.7500

Table -4 Densities and viscosities of systems in Acetone-Water at 29°C(±0.1°C)
System: Ligand -L_2

Sr. No.	Concentration C (mole/liter)	$\sqrt{c} \times 10^{-2}$ (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50×10^{-4}	7.0711	0.906	54	1.2915	4.1231
2	40×10^{-4}	6.3246	0.937	56	1.3851	6.0937
3	30×10^{-4}	5.4772	0.952	53	1.3319	6.0566
4	20×10^{-4}	4.4721	0.959	49	1.2404	5.3781
5	10×10^{-4}	3.1623	0.963	45	1.1439	4.5538

Table-5 A and β coefficient values in Methanol-Water Medium

Sr. No.	System	A	β (lit/mole)
1	Lgand-L1	+4.453	+0.574
2	Lgand-L2	+2.527	+0.075

Table-6A and B coefficient values in Acetone-Water Medium

Sr. No.	System	A	β (lit/mole)
1	Lgand-L1	-1.256	+1.069

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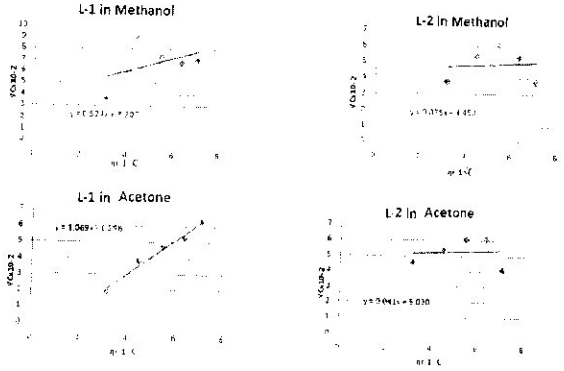
2	Lgand-L2	+5.020	+0.041

Graphs:



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DIVERSITY OF PHYTOPLANKTON OF FRESHWATER OF PAINTAKLI DAM OF BULDHANA DISTRICT (M.S.), INDIA

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Abstract

The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Investigative study is related with analysis and diversity of phytoplankton of Paintakali dam of Buldhana District (M.S.) for duration of one year from July 2016 to June 2017. Investigated study of planktons was divide into phytoplanktons from these phytoplankton were belong to genera of different groups like as Chlorophyceae, Euglenophyceae, Bacillariophyceae and Myxophyceae. During investigation period Chlorophyceae are higher in population density and dominant from different of spots of Paintakali dam.

Keywords: Bacillariophyceae, Phytoplankton, Chlorophyceae, Paintakali dam.

INTRODUCTION

The problems relates to water borne diseases attract the attention to the urgency for investigating causes and suggest remedies to prepare future plan of action for maintenance of potable waters and related development issues. It is essential for all living things for the survival on this earth planet. Planktons are the groups of microscopic plants and animals which are minute and able to spend their whole life floating in the water is called as planktons. The name plankton was given by Hansen. Plankton has very flexible locomotary organs. They are unable to move rapidly and also unable to determine direction of their movement. Water is the nature's most wonderful, abundant and most useful chemical compound created by nature with biological, chemical, physical properties, as well as diversity of phytoplankton's and unique characteristics.

It is the most abundant and elixir of life and essential chemical, but this vast natural resource has been depleted and turned into scarce commodity with increased usage catering to the needs of ever-expanding population. There is almost a global shortage of water and the world's most important and front rank problem is to supply and maintain cheap and clean drinking water today to everyone.

The present investigation involves collection, observation and identification of phytoplankton found in water of Paintakli dam of Buldhana district located in Maharashtra, India.

MATERIALS AND METHODS

Sample Collection and Analysis-

In the present study the phytoplankton diversity and the physico-chemical properties of the lake water were studied for monsoon and post monsoon season. Monthly collections of water samples were collected from sampling site for one complete year from July 2016 to June 2017. Samples are collected from sampling sites on months first week at 6.00 a.m. to 10.00 a.m. Plankton net of bolting silk no. 25 was used for sampling purpose. Samples were taken at mid stream 0.5 to 1 m below the surface of water. Plankton samples were collected, fixed and preserved in 5% formalin. Samples were observed under light microscope at 40 – 100X resolution power and identified up to genus and species level with the help of books and keys. (Patterson, 1998 Adoni, 1985).

RESULT AND DISCUSSION

In present investigation phytoplankton were belong to genera of different groups like as Chlorophyceae, Euglenophyceae, Bacillariophyceae and Myxophyceae. During

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investigation period Chlorophyceae are higher in population density and dominant. Over that Euglenophyceae are showing less population in the study period. Similar results was found to Manoj Kumar et al, (2015) reported phytoplankton diversity, Chlorophyceae (12 species of 11 genera), Euglenophyceae (3 species of 2 genera), Bacillariophyceae (5 species of 5 genera), and Cyanophyceae (15 species of 7 genera) from Yamuna River at Kalpi. Kadam et al, (2014) reported findings on phytoplankton diversity of reservoirs in Parbhani District, Maharashtra, India they find 37 species of Chlorophyceae, 47 species of Cyanophyceae, 34 species of Bacillariophyceae, 07 species of Euglenophyceae, and 04 species of Dinophyceae. Bamane et al, (2013) studied on phytoplankton diversity of Upvan-lake, Thane, Maharashtra, India reported in his investigation phytoplankton species of Chlorophyta are 13 species, Bacillariophyta 05 species, and Cyanophyta are 02 species.

Sr. No.	Taxonomic Description of Phytoplankton Diversity	
1.	**Phylum : Chlorophyceae**	Scenedesmus dimorphus
2.	**Phylum : Euglenophyceae**	Euglena acus
		Euglena triptis
		Phacus orbicularis
3.	**Phylum : Bacilirophyceae**	Cocconeis sp.
		Navicula rhomboide
		Navicula mutica
		Synendra ulna
		Synendra acus
4.	**Phylum : Myxophyceae**	Oscillatoria
		Microcystasis aeruginosa
		Microcystasis protocystis
		Sphaerocyatis schroeteri
		Oocystic saliteria
		Aphanocapsa
		Lynghya

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CONCLUSION

The present investigation has been focused on plankton's diversity including phytoplankton of Paintakali dam water with specific environmental associations. This investigation also focuses on reducing the water pollution due to human activity and helps in improve social and cultural importance of dam and its scenario. Our results will help for assessing the potable nature of dam water.

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22. Identification and Purity Determination of Albendazole by HPLC Method

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Abstract

Albendazole is an anthelmintic (an-thel-MIN-tik) or anti- worm medication.It prevents newly hatched insect larvae (worms) from growing or multiplying in your body. Albendazole is used to treat certain infections caused by worms such as pork tapeworm and dog tapeworm. Albendazole is an antihelmintic agent used predominantly in treatment of echinococcosis, a parasitic worm that causes cysts in liver and lung.

KeyWords: Albenza,Melting point,Percentage purity, injection method

Introduction

Albendazole therapy is commonly associated with mild and transient serum enzyme elevations and rarely can lead to clinically apparent acute liver injury.Albendazole (al ben' da zole) is a benzimidazole antihelmintic agent similar in structure and mechanism of action to thiabendazole and mebendazole and the veterinary agent fenbendazole. The benzimidazoles act by selective binding to beta-tubulin of parasitic worms, causing their immobilization and death. Albendazole has proven efficacy against several parasitic worms and was approved for use in the United States in 1996.

Currently indications for Albendazole include echnicoccosis, cysticercosis and strongyloidiasis against which it is more effective than mebendazole (largely because it is better absorbed). Albendazole is also used for hookworm, whipworm and pinworm ALBENZA (Albendazole) is an orally administered anthelmintic drug. Chemically, it is methyl 5(propylthio)-2-benzimidazolecarbamate. Its molecular formula is $C_{12}H_{15}N_3O_2S$.

Its molecular weight is 265.34. It has the following chemical structure:

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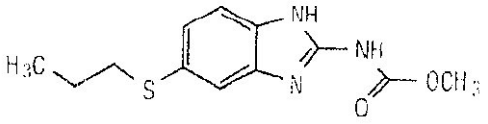

Albendazole is a white to yellowish powder. It is freely soluble in anhydrous formic acid and very slightly soluble in ether and in methylene chloride. Albendazole is practically insoluble in alcohol and in water.

Methodology

Melting point is one of the key parameter to identify the drug and its crystalline state. Moreover, variation in melting point gives the clue of drug substance purity. Melting point of Albendazole is determined by open capillary tube method. Albendazole is placed in separate capillary tubes closed at one end that inserted into different channels of furnace after attaining the desired set temperature. The progress in temperature is monitored. The point at which drug melting starts is noted. The experiment is carried out in duplicate. The average melting point is considered as the melting point of the drug.

Identification by UV- Vis Spectrophotometry

The power of radiant beam decreases in relation to the distance that, it travel through an absorbing medium. It also decreases in relation to concentration of absorbing molecule or ions encountered in that medium. These two factors determine proportion of the total incident energy that emerge

The decrease in power of monochromatic light passing through the homogeneous medium is stated quantitatively by Beer's law.

$$\log (1/T) \text{ or } \quad A = abc$$

The instrument used for spectroscopic analysis is an optical device suitable for measuring the UV and visible monochromatic light in the range to 200-800 nm and a device suitable for measuring the absorbance.

Determination of Purity by HPLC

High-performance liquid chromatography (**HPLC**; formerly referred to as **high-pressure liquid chromatography**, is a technique in analytical chemistry used to separate, identify, and quantify each component in a mixture. It relies on pumps to pass a pressurized

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liquid solvent containing the sample mixture through a column filled with a solid adsorbent material.

Each component in the sample interacts slightly differently with the adsorbent material, causing different flow rates for the different components and leading to the separation of the components as they flow out the column.HPLC has been used for manufacturing (*e.g.* during the production process of pharmaceutical and biological products), legal (*e.g.* detecting performance enhancement drugs in urine), research (*e.g.* separating the components of a complex biological sample, or of similar synthetic chemicals from each other), and medical (*e.g.* detecting vitamin D levels in blood serum) purposes.

A digital microprocessor and user software control the HPLC instrument and provide data analysis. Some models of mechanical pumps in a HPLC instrument can mix multiple solvents together in ratios changing in time, generating a composition gradient in the mobile phase. Various detectors are in common use, such as UV-Vis, photodiode array (PDA) or based on mass spectrometry. Most HPLC instruments also have a column oven that allows for adjusting the temperature at which the separation is performed.

Preparation of the Mobile Phase

250 ml of mobile phase was prepared by mixing methanol and water in the proportion of 80:20 ratio.

Preparation of Stock Solution

Accurately weighed 25.0 mg of Albendazole, dissolved in 50 ml of mobile phase. Solution had been sonicated for 2.0 minutes. 1ml of stock solution was further diluted to 10 ml with mobile phase.

Table No. 1: Results Obtained from Injection No. 1

Sr. No.	Retention time	Name	Area	% Area	Theoretical plates	Asymmetry
1	4.000	Unk. impurity	8995	0.61	9445	1.03
2	4.950	ALBENDAZOLE	1477127	99.39	10152	1.04

Table No. 2: Results Obtained from Injection No. *2*

Sr.No.	Retention time	Name	Area	% Area	Theoretical plates	Asymmetry
1	4.000	Unk. impurity	8513	0.57	10040	1.07
2	4.950	ALBENDAZOLE	1473910	99.43	10271	1.04

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Result and Discussion

The drug obtained was evaluated for its physical properties, description, identification and percent purity. The drug is white coloured, amorphous powder. For the identification tests two tests were performed a) Melting point and b) By spectrophotometric analysis. Melting point was found to be 208.15°C which is well within the range. The spectrophotometric analysis is carried out as per I.P. Spectrum is scanned between 200- 400 nm and the λmax was found at 294 nm.

Table No. 3: Percentage Purity of Albendazole

Sr. No.	Name of the drug	Particulars	(Inj. 1)	(Inj. 2)	Avg.
1	ALBENDAZOLE	% Unknown Impurity	0.61	0.57	0.58
2		% Purity	99.39	99.43	99.42

Percent purity by HPLC of Albendazole sample is found satisfactory. Asymmetry and No. of theoretical plates found satisfactory. The Identification tests A & B carried out for identifying the drug found to be satisfactory and comply with the Pharmacopieal requirements. Melting point of Albendazole sample is complying with standard reported value. Maximum wavelength obtained matches with the reported value. Hence the Project work carried out for identification and Purity determination of Albendazole by HPLC yield satisfactory results.

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Synthetic and Biological Evaluation of 3, 4- Dihydropyrimidin-2-(1H)-ones by using Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as Nano Catalyst

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Abstract:

The present study aimed to use a method for the synthesis of some 3, 4 - dihydropyrimidin-2-(1H) - ones by using Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as Catalyst. The study tried to study the Biginelli reaction can be performed without solvent and with new catalyst or not. To find the effectiveness of the catalyst (PANI-Co), we described a novel protocol for the efficient synthesis of some 3, 4-dihydropyrimidin-2- (1H) - one using aldehydes, alkyl acetoaccetate, and urea or thiourea at 80°C under solvent-free conditions by Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as Catalyst. This catalyst is efficient due to its impact as high yields, mild reaction conditions, eco friendly protocol, cost effectiveness and reusability.

The synthesized compounds were characterized by spectroscopic techniques. The synthesized compounds were evaluated for antimicrobial activity. The results showed that these compounds show a remarkable biological activity against all the tested bacteria. We have demonstrated a novel method for the synthesis of substituted dihydropyrimidinones catalyzed by Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as Catalyst.

Keywords: Cobalt Chloride Doped Polyaniline composite (PANI-Co), DHPMs, antimicrobial activities, Biginelli reaction, MIC.

Introduction:

The Italian chemist Pietro Biginelli in 1893 made an attempt to synthesize Dihydropyrimidinones (DHPMs) through multicomponent reactions [1] Biginelli reaction is the multi-component reaction (MCR) used for the synthesis of dihydropyrimidinones/thiones. The 3,4- dihydropyrimidin-2 (1H) ones / thiones (DHPMs) exhibit the antimicrobial activities such as anti-bacterial, anti-viral, anti- hypertensive, calcium channel modulators and Multi-drug

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resistance reversal [2- 7]. Biginelli reaction is suffered from minimum yield of products [8]. In the recent year researchers tried to develop the new method to improve the yield of the product by using the different catalyst and reaction conditions. i.e. the use of bismuth(III) nitrate [9], $Al(NO_3)_3 9H_2O$[10], $CuCl_2 2H_2O$ [11], $RuCl_3$ [12], Glutamic acid [13], $ZrCl_4$ [14], silica sulfuric acid [15], thiamine hydrochloride [16], L-(+)-tartaric acid-dimethylurea [17], polyvinylsulfonic acid [18], imidazole-1–yl-acetic acid [19], $[Al(H_2O)_6](BF_4)_3$ [20], p-TsOH.H_2O[21], H_3BO_3 [22], $HClO_4$-SiO_2 [23], $SnCl_2.II_2O$ [24], mesoporous silica catalyst ,chlorosulfonic acids [25], triphenyl phosphine [26], Al-platedMCM-41[27], $(NH_4)_2CO_3$[28], $CrCl_3.7H_2O$ [29], $CaCl_2$[30], y- aminobutyric acid [31], SiO2-H2SO4 [32], $Ce(NH_4)_2(NO_3)_6$[33],alumina- supported trifluromethane sulfonic acid [34], chloro-trimethyl silane [35], NaCl[36], $SrCl_2.6H_2O$ [37], and other reagents have been found to be effective.

However, some of these methods are expensive and harmful to the environment and gives low yields, incompatibility with other functional groups and isolation of product is difficult. Therefore, there is need to develop the low cost, ecofriendly catalyst for the synthesis of 3, 4- Dihydropyrimidin - 2-(1H)-one.

The 3, 4- Dihydropyrimidin - 2-(1H)-one Biginelli compounds [38] has increased the scope in medicinal chemistry. The dihydropyrimidinones exhibit wide range of biological activities such as antibacterial, antiviral, antitumor, and anti-inflammatory actions [39]. Due to its biological activities scientist attracts towards synthetic and biological evaluation of the Biginelli compounds.

The much work is carried out related with the synthetic methodology and biological evaluations of these compounds. The synthesis of industrially important and other nitrogenous biologically active compounds has long been a significant branch of organic synthesis [40-42].

In the present work we have synthesized the some 3, 4- Dihydropyrimidin - 2-(1H)-ones by using Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as the nano Catalyst and studied the antimicrobial activity of these compounds.

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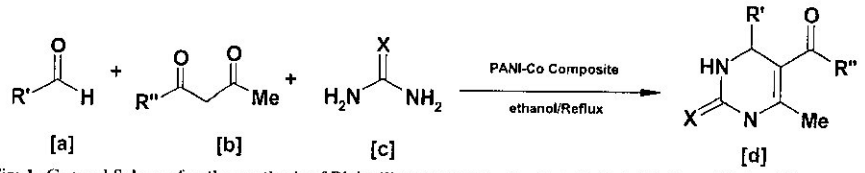

Fig: 1- General Scheme for the synthesis of Biginelli compounds using Cobalt Chloride Doped Polyaniline Composite (PANI-Co) as Catalyst

EXPERIMENTAL

Material:

All chemicals supplied by the Merck (Extra pure) and were used without further purification. IR spectra were recorded on a Perkin-Elmer 1640 FT-IR instrument. The 1H- and 13C-NMR spectra were recorded on a Bruker DPX-300 NMR machine. Unless otherwise specified, $CDCl_3$ was used as a solvent. Mass spectra were recorded with a Bruker Daltonic Data Analysis 2.0 spectrometer.

Preparation PANI-Co composite as a catalyst:

The Cobalt Chloride Doped Polyaniline (PANI-Co) composite as Catalyst was prepared by the chemical doping method. The polyaniline was synthesized by the chemical oxidization method at low temperature (0 to 3^0C). Ammonium Persulphate and Hydrochloric Acid has been used as the oxidizing agent as received without further purification. 10 ml Aniline was first dissolve in 2 M 100 ml Hydrochloric Acid (HCl) (Merk). Then this solution is kept in the ice bath below 5 ^{0}C. Ammonium Persulphate solution (Usually 10%) was added to the above solution with constant stirring for 3-4 hours. Finally the green color polyaniline is formed. It is washed with the hot dilute HCl and dried it in the oven for 24 Hours.

An appropriate amount of the Cobalt Chloride 0.1 M was dissolve in polyaniline (PANI) solution. Doping of cobalt is done by the chemical doping method. For uniform distribution of cobalt to form the Cobalt Chloride Doped Polyaniline (PANI-Co) composite stirring was continued for 2 hours. PANI-Co composite was formed and confirmed by the instrumental techniques and used as an effective catalyst.

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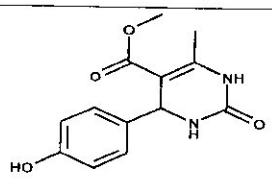
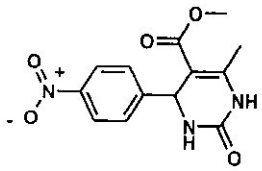
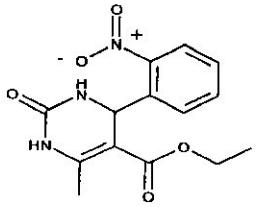
General procedure of synthetic 3,4-dihydropyrimidin-2(1H)-one: A mixture of aromatic aldehyde (1 mmol), 1,3-dicarbonyl compounds (1 mmol), urea or thiourea (1.5 mmol) was prepared. Cobalt Chloride Doped Polyaniline (PANI-Co) composite (3 mol %) was added as the catalyst. The mixture was dissolved in 2mL of absolute ethanol. The mixture was refluxed for suitable time and the progress of the reaction was monitored by TLC. After completion of the reaction, the catalyst was recovered by filtration, the filtrate was evaporated and the solid was then washed with cold water. The product has been recrystalized with ethanol to get the pure 3,4-dihydropyrimidin-2(1H)-ones.

Following DHPMs were synthesized:

Compound code	Name of the Compound	Structure of the compounds
BCa	methyl 4-(4-hydroxyphenyl)-6-methyl-2-oxo-1,2, 3,4-tetrahydropyrimidine-5-carboxylate or 5-(Methoxycarbonyl)-6-methyl-4-(4-hydroxyphenyl) -3,4-dihydropyrimidin-2(1H)-one	
BCb	methyl 6-methyl-4-(4-nitrophenyl)-2-oxo-1,2,3,4- tetrahydropyrimidine-5-carboxylate or 5-(Methoxycarbonyl)-6-methyl-4-(4-nitrophenyl)- 3,4-dihydropyrimidin-2(1H)-one	
BCe	ethyl 6-methyl-4-(2-nitrophenyl)-2-oxo-1,2,3,4- tetrahydropyrimidine-5-carboxylate or 5-(Ethoxycarbonyl)-6-methyl-4-(2-nitrophenyl)-3,4- dihydropyrimidin-2(1H)-one	

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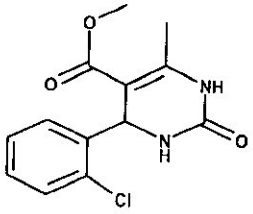
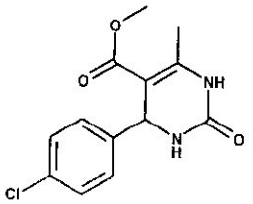
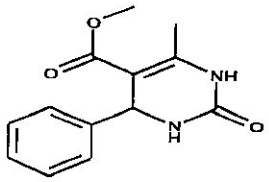
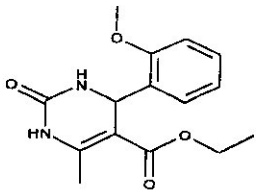
BCd	ethyl 4-(2-chlorophenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate or 5-(Ethoxycarbonyl)-6-methyl-4-(2-chlorophenyl)-3,4-dihydropyrimidin-2(1H)-one	
BCe	ethyl 4-(4-chlorophenyl)-6-methyl-2-oxo-1,2,3,4- tetrahydropyrimidine-5-carboxylate or 5-(Ethoxycarbonyl)-6-methyl-4-(4-chlorophenyl) - 3,4-dihydropyrimidin-2(1H)-one	
BCf	ethyl 6-methyl-2-oxo-4-phenyl-1,2,3,4-tetrahydropyrimidine-5-carboxylate or (5-(Ethoxycarbonyl)-6-methyl-4-phenyl-3,4-dihydropyrimidin-2(1H)-one)	
BCg	ethyl 4-(2-methoxyphenyl)-6-methyl-2-oxo-1,2,3,4- tetrahydropyrimidine-5-carboxylate or 5-(Ethoxycarbonyl)-6-methyl-4-(2-methoxyphenyl)- 3,4-dihydropyrimidin-2(1H)-one	

Table: 1- List of the biologically evaluated compounds

Reaction conditions: Aldehyde = 10 mmol, urea/thiourea=15 mmol, β-keto-ester =10 mmol, Catalyst = 20 wt. % with respect to wt. of aldehyde, Solvent free, Temp. = 25^{0}C by using the Cobalt Chloride Doped Polyaniline (PANI-Co) composite (3 mol %) as catalyst. All compounds are well characterized by spectroscopic techniques.

Evaluation of biological activities of 3, 4- dihydropyrimidinones:

The synthesized Biginelli compounds (BCs) i. e. BCa, BCb, BCc, BCd, BCe, BCf and BCg were tested against the bacterial species using cup plate method and their minimum inhibitory concentrations (MIC) were determined by using broth macro dilution method. The organisms used for these method include *Staphylococcus aureus, Escherichia coli, Shigella dysentariae,*

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Klebsiella pneumoniae, Proteus mirabilis, Salmonella typhi, Bacillus subtilis, Bacillus megatherium, Proteus vulgaris and *Pseudomonas aeruginosa*.

RESULTS AND DISCUSSION

The antimicrobial activity of Biginelli compounds (BC) i. e. BCa, BCb, BCc, BCd, BCe, BCf and BCg was assessed against the test organisms *Staphylococcus aureus, Escherichia coli, Proteus vulgaris, Bacillus Subtilis, Pseudomonas aeruginosa, Bacillus megatherium, Salmonella typhi, Shigella dysentariae Klebsiella Pneumoniae* and *Proteus mirabilis*. All bacterial species used in present investigation are known human pathogens. The MIC values were determined by serial dilution method. The comparative study of MIC values of the compounds is given in Table-2. The results of sensitivity of various pathogens towards the synthesized Biginelli compounds were tested. The results of sensitivity of pathogens towards the synthesized DHPMs (BCa-BCg) are shown.

For convenience, the compounds were graded as -

i. Highly active : With MIC values > 3 to 12.5 µg/ml
ii. Moderately active : With MIC values > 25 to µg/ml
iii. Poorly active : With MIC values > 100 – 200 µg/ml

Most of the Biginelli compounds show moderate activity with MIC values in the range > 3 to 200 µg/ml towards Gram positive and Gram negative micro-organisms. The compounds BCa and BCg possess highest activity with MIC values 3 to 6.2 µg/ml. towards all the bacteria tested.

Compounds→ Microbes↓	BCa	BCb	BCc	BCd	BCe	BCf	BCg
Staphylococcus aureus	12.5	100	3.0	100	6.2	25	50
Escherichia coli	12.5	50	>3.0	25	6.2	12.5	50
Proteus vulgaris	25	100	>3.0	25	>3.0	12.5	6.2
Bacillus Subtilis	3.0	25	6.2	25	>3.0	25	100
Pseudomonas aeruginosa	25	25	6.2	50	6.2	6.2	12.5
Bacillus megatherium	12.5	100	6.2	50	6.2	50	100
Salmonella typhi	100	50	3.0	25	3.0	50	100
Shigella dysentariae	50	25	3.0	12.5	>3.0	25	50
Klebsiella Pneumoniae	25	100	>3.0	25	3.0	12.5	25
Proteus mirabilis	12.5	25	>3.0	50	6.2	25	50

Table: 2- Comparative study of MIC values of DHPMs against micro-organisms

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Compounds BCb, and BCd were less active towards all the pathogens excepting *Pseudomonas aeruginosa* and *Proteus vulgaris* respectively. Compounds BCg were less active with respect to antimicrobial activity towards used pathogens. The compound BCa, BCc, BCe and BCf is exceptionally sensitive towards *S. dysentariae.*

CONCLUSION

The Biginelli compounds was found have the considerable antimicrobial activity toward the all the pathogenic bacteria BCa . Where as in case of comounds BCb, and BCd the results were exceptionally appreciable towards the micro- organisms *Pseudomonas aeruginosa, Proteus vulgaris, Shigella dysentariae, Bacillus subtilis, Bacillus megatherium, Proteus vulgaris, Bacillus subtilis* and *Shigella dysentariae.*

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15. Identification and Purity Determination of Caffeine by HPLC Method

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Abstract

Caffeine is a central nervous system (CNS) stimulant of the methylxanthine class. It is the world's most widely consumed psychoactive drug. Unlike many other psychoactive substances, it is legal and unregulated in nearly all parts of the world. There are several known mechanisms of action to explain the effects of caffeine.The most prominent is that it reversibly blocks the action of adenosine on its receptor and consequently prevents the onset of drowsiness induced by adenosine.Caffeine also stimulates certain portions of the autonomic nervous system.Caffeine is a bitter, white crystalline purine, a methylxanthine alkaloid, and is chemically related to the adenine and guanine bases of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). It is found in the seeds, nuts, or leaves of a number of plants native to South America and East Asia and helps to protect them against predator insects and to prevent germination of nearby seeds. The most well known source of Caffeine is the coffee bean, a misnomer for the seed of Coffea plants. Beverages containing Caffeine are ingested to relieve or prevent drowsiness and to improve performance. To make these drinks, caffeine is extracted by steeping the plant product in water, a process called infusion. Caffeine-containing drinks, such as coffee, tea, and cola, are very popular; as of 2014, 85% of American adults consumed some form of caffeine daily, consuming 164 mg on average.

Keywords: Determination of purity, UV-Vis spectroscopy, chromatography, Coffine, experimental

Introduction

Caffeine can have both positive and negative health effects. It can treat and prevent the premature infant breathing disorders bronchopulmonary dysplasia of prematurity and apnea of prematurity. Caffeine citrate is on the WHO Model List of Essential Medicines. It may confer a

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modest protective effect against some diseases, including Parkinson's disease. Some people experience sleep disruption or anxiety if they consume caffeine, but others show little disturbance. Evidence of a risk during pregnancy is equivocal; some authorities recommend that pregnant women limit consumption to the equivalent of two cups of coffee per day or less. Caffeine can produce a mild form of drug dependence – associated with withdrawal symptoms such as sleepiness, headache, and irritability – when an individual stops using caffeine after repeated daily intake. Tolerance to the autonomic effects of increased blood pressure and heart rate, and increased urine output, develops with chronic use (i.e. these symptoms become less pronounced or do not occur following consistent use).

Caffeine is classified by the US Food and Drug Administration as "generally recognized as safe" (GRAS). Toxic doses, over 10 grams per day for an adult, are much higher than typical doses of under 500 milligrams per day. A cup of coffee contains 80–175 mg of caffeine, depending on what "bean" (seed) is used and how it is prepared (e.g. drip, percolation, or espresso). Thus it requires roughly 50–100 ordinary cups of coffee to reach a lethal dose. However pure powdered caffeine, which is available as a dietary supplement, can be lethal in tablespoon-sized amounts.

Methadology

Melting point is one of the key parameter to identify the drug and its crystalline state. Moreover, variation in melting point gives the clue of drug substance purity. Melting point of Caffeine is determined by open capillary tube method. Caffeine is placed in separate capillary tubes closed at one end that inserted into different channels of furnace after attaining the desired set temperature.

The progress in temperature is monitored. The point at which drug melting starts is noted. The experiment is carried out in duplicate. The average melting point is considered as the melting point of the drug.

Table No. 1: Melting point of Caffeine

Sr. No.	Observed Melting Points	Average Melting Point	Limit
1.	235.0°c	235.0°c	234 - 238°c
2.	235.0°c		

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Identification by UV- Vis Spectrophotometry

The power of radiant beam decreases in relation to the distance that, it travel through an absorbing medium. It also decreases in relation to concentration of absorbing molecule or ions encountered in that medium. These two factors determine proportion of the total incident energy that emerge. The decrease in power of monochromatic light passing through the homogeneous medium is stated quantitatively by Beer's law,

$$\log (1/T) \text{ or } \quad A = abc.$$

The instrument used for spectroscopic analysis is an optical device suitable for measuring the UV and visible monochromatic light in the range to 200-800 nm and a device suitable for measuring the absorbance

Operation of the Instrument

As the system is Turn "ON" and clicked the icon on the instrument, instrument automatically connected to computer software. The cuvettes are hold from the top to prevent tampering with the measurements, and wiped the sides with a lab tissue. Then the panel door is opened and placed the cuvette with blank solution in the cuvette holder. The appropriate orientation for the cuvette before reusing is ensured. Filled an empty cuvette with about 2-ml of the sample solution Cleaned the cuvette with a lab tissue. Pressed START key to take reading. Saved the Spectrum. Opened panel door and removed test sample from front cuvette holder.

Preparation of Solution

Accurately weighed 10.0 mg of Caffeine and dissolved in 10 ml of methanol. Solution is sonicated for 2.0 minutes. (Stock solution). Further 1ml of above stock solution is diluted to 10 ml with methanol. 1ml of this solution is diluted to 10 ml with methanol. This solution is scanned in Spectrum mode in the UV range of 400-200 nm. Spectra is observed as

UV Spectra of Caffeine (λ max 273 nm)

Sr.No	P/V	Wavelength(nm)	Abs
1	Peak	273.00	0.786
2	Peak	217.00	0.768

Determination of Purity by HPLC

High-performance liquid chromatography (HPLC; formerly referred to as **high-pressure liquid chromatography**, is a technique in analytical chemistry used to separate, identify, and quantify each component in a mixture. It relies on pumps to pass a pressurized

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liquid solvent containing the sample mixture through a column filled with a solid adsorbent material. Each component in the sample interacts slightly differently with the adsorbent material, causing different flow rates for the different components and leading to the separation of the components as they flow out the column.HPLC has been used for manufacturing (e.g. during the production process of pharmaceutical and biological products), legal (e.g. detecting performance enhancement drugs in urine), research (e.g. separating the components of a complex biological sample, or of similar synthetic chemicals from each other), and medical (e.g. detecting vitamin D levels in blood serum) purposes.

Chromatography can be described as a mass transfer process involving adsorption. HPLC relies on pumps to pass a pressurized liquid and a sample mixture through a column filled with adsorbent, leading to the separation of the sample components.

The active component of the column, the adsorbent, is typically a granular material made of solid particles (e.g. silica, polymers, etc.), 2–50 µm in size. The components of the sample mixture are separated from each other due to their different degrees of interaction with the adsorbent particles. The pressurized liquid is typically a mixture of solvents (e.g. water, acetonitrile and/or methanol) and is referred to as a "mobile phase". It's composition and temperature play a major role in the separation process by influencing the interactions taking place between sample components and adsorbent.

These interactions are physical in nature, such as hydrophobic (dispersive), dipole–dipole and ionic, most often a combination.HPLC is distinguished from traditional ("low pressure") liquid chromatography because operational pressures are significantly higher (50–350 bar), while ordinary liquid chromatography typically relies on the force of gravity to pass the mobile phase through the column. Due to the small sample amount separated in analytical HPLC, typical column dimensions are 2.1–4.6 mm diameter, and 30–250 mm length.

Also HPLC columns are made with smaller adsorbent particles (2–50 µm in average particle size).This gives HPLC superior resolving power (the ability to distinguish between compounds) when separating mixtures, which makes it a popular chromatographic technique.

Apparatus and Chromatographic Conditions: The equipment used was High Performance Liquid Chromatography Equipped with Auto Sampler and UV Detector. The RP 18 column (250 mm x 4.6 mm; 5 µ) was selected for analysis. The flow rate was maintained at 1.0 mL/min. The detection was carried out at 272 nm. The run time was adjusted at 10 min.

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Preparation of the mobile phase: 250 ml of mobile phase was prepared by mixing methanol and water in the proportion of 70:30 ratio.

Preparation of solution: Accurately weighed 10.0 mg of Caffeine and dissolved in 10 ml of methanol. Solution is sonicated or 2.0 minutes. (Stock solution). Further 1ml of above stock solution is diluted to 10 ml with methanol.

Table No. 2: Results Obtained from Injection No. 1

Sr. No.	Retention time in min	Name	Area	% Area	Asymmetry	Theoretical plates
1	2.483	UNK. IMP.	19744	0.64	1.11	3824
2	2.637	UNK. IMP.	4026	0.13	1.20	10984
3	3.032	CAFFEINE	3039005	99.22	1.31	2858

Table No. 3: Results Obtained from Injection No. 2

Sr.No.	Retention time in min	Name	Area	% Area	Asymmetry	Theoretical plates
1	2.492	UNK. IMP.	18180	0.60	1.00	4438
2	2.640	UNK. IMP.	4482	0.15	1.24	10249
3	3.030	CAFFEINE	2991655	99.25	1.34	2842

Result and Discussion

The drug obtained was evaluated for its physical properties, description, identification and percent purity. The drug is white coloured, amorphous powder. For the identification tests two tests were performed a) Melting point and

b) By spectrophotometric analysis. Melting point was found to be 2.15°C which is well within the range. The spectrophotometric analysis is carried out as per I.P. Spectrum is scanned between 200- 400 nm and the λmax was found at 273 nm.

Table No. 4: Percentage Purity of Caffeine

Sr. No.	Name of the drug	Particulars	(Inj. 1)	(Inj. 2)	Avg
1	CAFFEINE	%Unknown impurity	0.64%	0.60%	0.62%
2		% Unknown impurity	0.13%	0.15%	0.14%
3		% Caffeine	99.22%	99.25%	99.24%

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Conclusion

Percent purity by HPLC of Caffeine sample is found satisfactory. Asymmetry and No. of theoretical plates found satisfactory. The Identification tests A & B carried out for identifying the drug found to be satisfactory and comply with the Pharmacopieal requirements. Melting point of Caffeine sample is complying with standard reported value. Maximum wavelength obtained matches with the reported value. Hence the Project work carried out for identification and Purity determination of Caffeine by HPLC yield satisfactory results

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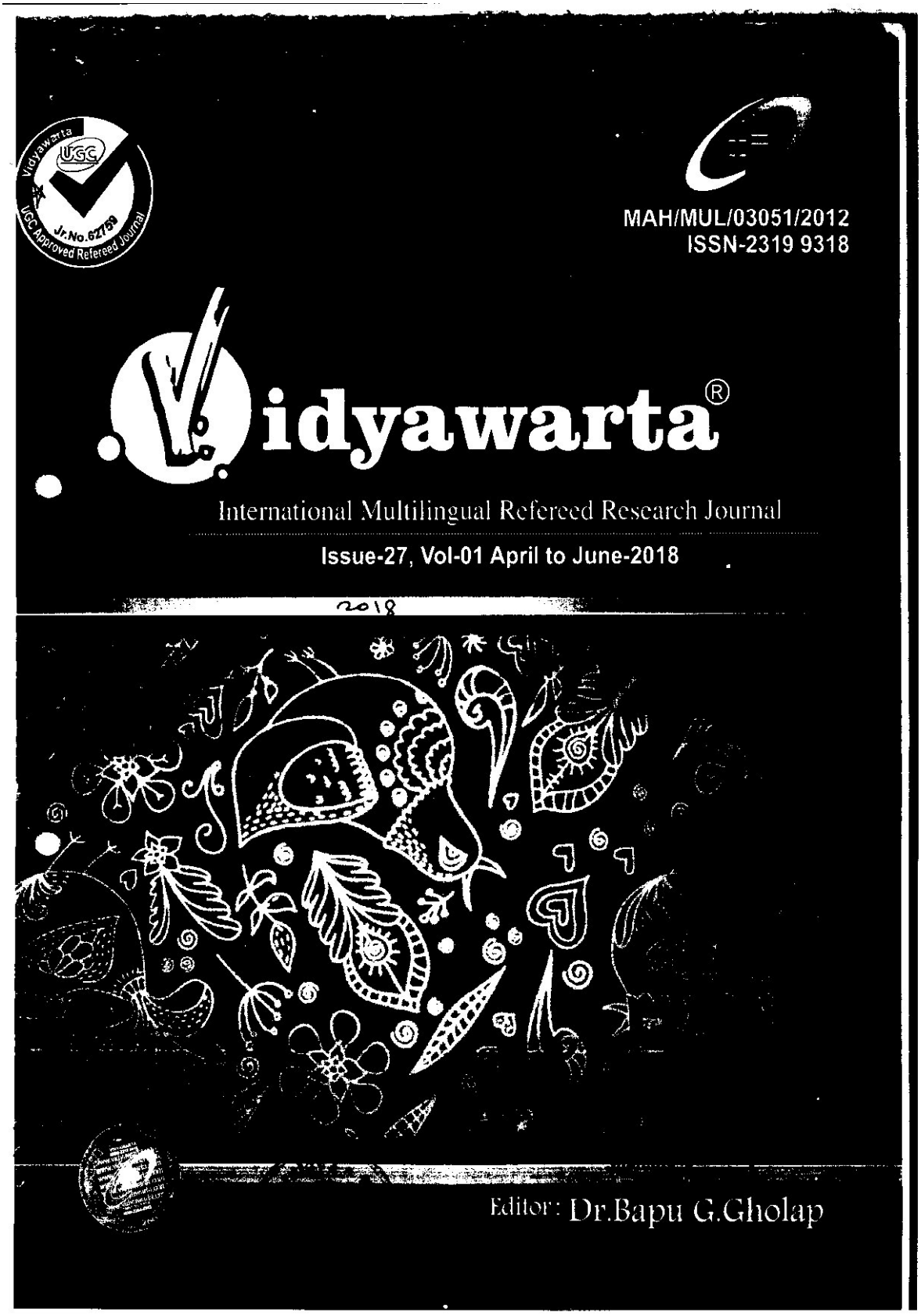
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IMPACT OF DEMONETIZATION ON BANKING SECTOR

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Introduction:

Demonetization is a tool to battle Inflation, Black Money, Corruption and Crime, discourage a cash dependent economy and help trade. Its policy of the government by banning Rs. 500 and Rs.1000 currency notes has influenced all almost all the corner of the economy. Hereby analyzing the impact of demonetization on Banking Sector. A study by Bhupal Singh and Indrajit Roy, RBI directors from the monetary policy department and department of statistics and information management, published in August this year showed that the excess deposits accrued to the banking system due to demonetisation range between Rs 2.8-4.3 trillion. "Excess deposit growth in the banking system during the demonetisation period (i.e., November 11, 2016 to December 30, 2016) works out to 4-4.7 percentage points. If the period up to mid-February 2017 is taken into account to allow for some surge to taper off, excess deposit growth is in the range of 3.3-4.2 percentage points. The liquidity boost resulting from the demonetisation announcement on November 8, 2016 has stayed with the banking sector a year after the event, helping banks reduce their high-cost deposits and boosting their current account and savings account (CASA) ratio. CASA is abbreviation of current Account Savings Account. It is the ratio which indicates how much of the total deposits with bank in the current account and savings account. In a simple language, the deposits with the bank are in the current account and savings account. Banks do not pay interest on the current account deposits and pays a very low% of interest on savings on account deposits. Hence, it is a good measures to get deposits at no or very low cost. **Thus influences of demonetization are:** • **Increase in Deposits:** Demonetization has increased the deposits in Banks. Unaccounted money in the form of Rs.500 and Rs.1000 were flowing to the Banks and the sizes of deposits have been increased. It helped the banks to grab the deposits and increase their deposits. Bulk of the deposits so mobilised by SCBs have been deployed in: (i) reverse repos of various tenors with the RBI; and (ii) cash management bills (CMBs) issued under the Market Stabilisation Scheme (which is a part of investment in government securities in the balance sheet of banks). Loans and advances extended by banks increased by Rs.1,008 billion. The incremental credit deposit ratio for the period was only 18.2 per cent. Additional deposits mobilised by commercial banks have been largely deployed in liquid assets. • **Fall in cost of Funds:** Over the past few months, the deposits are increased. It led the banks to keep a major part of deposits in the form of cash deposits. PSU Banks have a lion share (over 70%) of the deposits and biggest gainers of the rise in deposits, leading to lower cost of funds. Surplus liquidity conditions have helped facilitate the transmission of monetary policy to market interest rates. Post demoneti sation, several banks lowered their domestic term deposit rates and lending rates. The median term deposit rates of SCBs declined by 38 bps during November 2016-February 2017, while the weighted average term deposit rate of banks declined by 24 bps (up to January 2017). Combined with the sharp increase in low cost CASA deposits, the overall cost of borrowings declined, allowing banks to reduce their lending rates. • **Demand for Government**

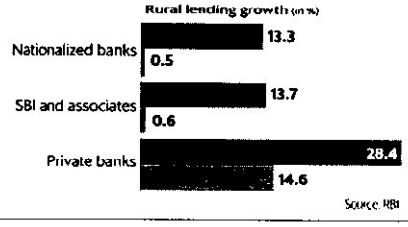
Bonds: After sharp rise in deposits on post demonetization, banks started lending such surplus deposits to the RBI under the reverse repo options. PSU Banks, particularly, deployed excess funds in government bonds. The return on bond investment is likely to add 15 to 20 per cent increase in the earnings of banks. • **Sagginess in Lending:** Lending growth of the banks is considerably less even after demonetization and its impact of growth in the amount of public deposit. Banks have tried to lend the money to the needy group by reducing their interest rates, but it shrunk over the last few months. **Opening of Jan Dhan Account** Post-demonetisation, 23.3 million new accounts were opened under the Pradhan Mantri Jan Dhan Yojana (PMJDY), bulk of which (80 per cent) were with public sector banks. Of the new Jan Dhan accounts opened, 53.6 per cent were in urban areas and 46.4 per cent in rural areas. Deposits under PMJDY accounts increased significantly post demonetisation. The total balance in PMJDY deposit accounts peaked at Rs. 746 billion as on December 7, 2016 from Rs. 456 billion as on November 9, 2016 - an increase of 63.6 per cent. As there were reports regarding the use of these accounts to convert black money into white, the Government issued a warning against the misuse of such accounts. **Push to Digital Banking** A cashless economy is one in the flow of cash within an economy is non-existent and all transactions have to be through electronic channels such as direct debit, credit and debit cards, electronic clearing, payment systems such as Immediate Payment Service (IMPS), National Electronic Funds Transfer and Real Time Gross Settlement in India. **Benefits of Cashless economy.**

• Reduced instances of tax avoidance because it is financial institutions based economy where transaction trails are left. • Curb generation of black money. • IT will reduce real estate prices because of curbs on black money. • It will place [illegible] availability of banking services to all as no physical infrastructure is needed other than digital. • There will be greater efficiency in welfare programmes as money is wired directly into the accounts of recipients. • Reduced cost of printing notes, instances of their soiled or becoming unusable, counterfeit currency. • Reduced costs of operating ATMs. • Speed and satisfaction of operations for customers as no delays and queues, no interactions with bank staff required. **Digital transaction platforms • UPI:** Unified Payment Interface (UPI) allows you to make payments using your mobile phone as the primary device for transactions, through the creation of a 'virtual payment address', which is an alias for your bank account. UPI was launched by the National Payment Corporation of India (NPCI). • **BHIM App:** The Bharat Interface for Money (BHIM) in an initiative by the Govt to enable fast,secure and reliable cashless payments through mobile phones. BHIM is Aadhaar-enabled, inter- operable with other Unified Payment Interface (UPI) applications and bank accounts, and has been developed by the National Payments Corporation of India (NPCI). This seals the government's push towards digital payments after the demonetization that resulted in the scrapping of high-value Rs 1,000 and Rs 500 currency notes. • **Aadhar Pay:** There are lots of payment apps in the market. These are the UPI apps, SBI Pay, Paytm, Phonepe, Freecharge, mobile wallets etc. But, the Adhaar Payment App is special as you can pay through the Adhaar Payment App without phone. It is possible because you the customer does not require the app. The merchant or a person, who want money, have to arrange a smartphone, app, etc. The payer don't require anything. This app is made for the merchants and shopkeepers. Customer would only enjoy its benefits. The Adhaar Payment Appuses your fingerprints for the authentication. On the basis of this authentication, the money ispaid from your

Aadhaar linked account. • **IMPS:** Immediate Payment Service (IMPS) is an instant interbank electronic fund transfer service through mobile phones. It is also being extended through other channels such as ATM, Internet Banking, etc. • **POS terminals:** A point-of- sale (POS) terminal is a computerized replacement for a cash register. Much more complex than the cash registers of even just a few years ago, the POS system can include the ability to record and track customer orders, process credit and debit cards, connect to other systems in a network, and manage inventory. Generally, a POS terminal has as its core a personal computer, which is provided with application-specific programs and I/O devices for the particular environment in which it will serve. • **USSD:** USSD (Unstructured Supplementary Service Data) is a Global System for Mobile(GSM) Communication technology that is used to send text between a mobile phone and an application program in the network. Applications may include prepaid roaming or mobile chatting. **Challenges of a cashless rural economy • Currency dominated economy:** High level of cash circulation in India. Cash in circulation amounts to around 13 per cent of India's GDP. • **Transactions are mainly in cash:** Nearly 95 per cent of transactions take place in cash. Large size of informal/unorganized sector entities and workers prefer cash based transactions. They don't have required digital literacy. • **ATM use is mainly for cash withdrawals and not for settling online transactions:** There are large number of ATM cards including around 21 crore Rupaya cards. But nearly 92 per cent of ATM cards are used for cash withdrawals. Multiple holding of cards in urban and semi-urban areas show low rural penetration. • **Limited availability of Point of Sale terminals:** According to RBI, there are 1.44 million PoS terminals installed by various banks across locations at the end of July 2016. But most of them remain in urban/ semi-urban areas. • **Mobile internet penetration remains weak in rural India:** For settling transactions digitally, internet connection is needed. But in India, there is poor connectivity in rural areas. In addition to this, a lower literacy level in poor and rural parts of the country, make it problematic to push the use of plastic money on a wider scale. This is being overcome by application BHIM (Bharat Interface for Money) launched by the Prime Minister which will work on USSD i.e without mobile internet. **Demonetization crippled rural bank lending** The note ban hurt rural India, loan growth was far below its pre-demonetisation levels. Indeed, in the second half of FY2017, bank lending to rural Haryana, Punjab, Goa, Maharashtra and Kerala contracted. Lending to rural Maharashtra fell by as much as 9.2%. Putting that in perspective, bank loans in the second half of FY16 to rural Haryana increased by 18% and to rural Punjab by 12.2%, while rural Maharashtra saw an increase in lending of 5.8%. Not a single state had showed a contraction in rural lending in the second half of FY16. In other words, the slowdown in rural lending in the second half of FY17 was very abnormal and may be attributed largely to demonetisation.

All categories of banks slowed lending to rural India

The worst affected was lending by public sector banks, which serve the bulk of the rural population



The rural parts of western India bore the brunt, with credit growth falling by 5.1% in the second half of FY17. Rural northern India and metropolitan western India also saw very low credit growth. Nationalized banks' credit growth

was 2.7% in the FY17 second half, compared to 8.8% growth in second half FY16. SBI and its associates saw their credit growth fall to 7.8% in the second half of FY17 compared to 13.7% in the second half of the previous year. Private banks' credit growth was 10.1% in the second half of FY17 compared to 18.8% in the year-ago period. Clearly, every category of banks was affected. The negative impacts are because of regulation, costs of demonetisation, loss of opportunity and short-term damage to economy. • The 100% cash reserve requirement (CRR) on incremental deposits meant that banks did not earn any interest on Rs 3 lakhs crores of deposits for nearly a fortnight. • The waiver of ATM charges would result in banks losing Rs 20 in every transaction. • The waiver of merchant discount rate on cards would result in banks losing 1% in every card transaction. • Banks use third parties like cash logistics companies for cash transportation. Moving out Rs 15 lakh crore of currency notes and moving in Rs 7 lakh crore plus from currency chests would have cost several thousand crore. • As banks have been focused on exchanging currency notes, they have not been able to sell any loan products. • Some SME businesses have seen their sales drop 50–80% and could default in their instalments. They won't immediately be classified as NPAs because of some relaxations, but if the delay persists bank NPAs might worsen. • Uncertainty has resulted in drop in spending on high value items from credit cards. These are the transactions which are converted into EMIs and banks earn from them. Demonetization has led to the increase in the use of plastic cards, online Banking, opening of new accounts, number of customers in the branches and the use of ATM.

Conclusion

If MFIs, particularly the smaller MFIs, continue to experience worsening repayment rates and defaults, their sustainability is questionable. Bearing in mind the importance of microfinance for financial inclusion and livelihoods of a client-base of around 40 million, demonetisation has dealt a severe blow to the microfinance sector in more ways than one. It has considerably damaged the repayment behaviour and credit discipline that is central to the success of the microfinance model. Even if there is recovery in sight in the coming quarters, the report highlight the tremendous stress that the sector has borne following demonetisation.

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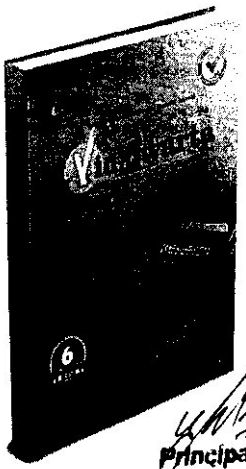

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Bianchi Type-III Interacting Holographic Polytropic Gas Model of Dark Energy with hybrid Expansion Law in General Relativity

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Research Paper - Mathematics

ABSTRACT

Bianchi type-III cosmological model have investigated when dark energy interacts with dark matter. The Einstein's field equations have been solved by using a hybrid expansion law. The correspondence between the holographic dark energy and polytropic gas model of dark energy model is established. The physical aspects of the models are also discussed.

Keywords: Bianchi type III space time, Holographic dark energy, Polytropic gas, Hybrid expansion law.

Introduction:

The universe is undergoing an accelerated expansion is the most remarkable observational discoveries in cosmology. Analysis of type-Ia supernovae (SN Iae) observations of anisotropies in the Cosmic Microwave Background Radiations (CMBR) and large scale structure (LSS) [1-6] has confirmed the accelerated expansion of the universe which is driven by an exotic energy with large negative pressure known as dark energy (DE). It is believed that the universe consists of 76% DE, 20% dark matter and 4% baryon matter. Usually DE is characterized by the equation of state (EoS) parameter

defined by $\omega(t) = \frac{p}{\rho}$, where p is the fluid pressure and ρ is the energy density. The simplest DE candidate is the vacuum energy $\omega = -1$ which is mathematically equivalent to the cosmological constant (Λ). Also EoS $-1 < \omega < \frac{1}{3}$ is called quintessence [7] and when $\omega < -1$ is phantom [8]. There are some other DE models which can cross the phantom divide $\omega = -1$ both sides are called quintom [9]. CMBR anisotropy collaborated with SN-Ia data and galaxy clustering statistics [10] are $-1.67 < \omega < -0.62$ and $-1.33 < \omega < -0.79$ respectively. However, it is not at all obligatory to use a constant value of ω. Due to lack of observational evidence in making a distinction between constant and variable ω, usually the EoS parameter is considered as a constant [11] [12] with phase wise values −1, 0, 1/3 and +1 for vacuum fluid, dust fluid, radiation and stiff fluid dominated universe respectively. But in general ω is a function of time or red shift [13-14]. Some cosmologist [15-19] studied dark energy cosmological model with different context.

As we know that in stellar astrophysics, the equation of state of degenerate white dwarfs, neutron stars and also the equation of state of main sequence stars are explained by the polytropic gas model [20]. We give a focus on Polytropic gas model as a dark energy model to explain the cosmic acceleration. The phenomenological model of dark energy are explained by polytropic gas model where the pressure p is a function of energy density [21]. The polytropic gas model has a type III Singularity where the singularity takes place at a characteristic scale factor. Malekjani and Mohammadi have investigated interacting polytropic gas model[22].

In this paper, we have investigated Bianchi type-III space-time with interacting holographic polytropic gas model of dark energy in general relativity. The Einstein's field equations have been solved by considering a hybrid expansion law. This work is organized as follows. In Section 2, the model and field equations have been presented. The field equations have been solved in Section 3. Correspondence between holographic and polytropic gas model of dark energy is discussed in section 4. In Section 5, the physical aspects of the model have been discussed. In the last Section 6, concluding remarks

have been expressed.

Metric and Field Equations:

Bianchi type-III metric has considered in the form of

$$ds^2 = dt^2 - a_1^2 dx^2 - a_2^2 e^{-2mx} dy^2 - a_3^2 dz^2, \quad (1)$$

where metric potentials a_1, a_2 and a_3 are functions of cosmic time t only.

The Einstein field equations is given by

$$R_{ij} - \frac{1}{2} R g_{ij} = -(T_{ij} + \bar{T}_{ij}), \quad (2)$$

where R_{ij} is the Ricci tensor, R is the Ricci scalar and T_{ij}, $\bar{T}_{ij}$ are the energy momentum tensor of dark matter and holographic dark energy respectively.

The energy momentum tensor for matter and holographic dark energy are defined as

$$T_{ij} = \rho_m u_i u_j \quad \text{and} \quad \bar{T}_{ij} = (\rho_\Lambda + p_\Lambda) u_i u_j + g_{ij} p_\Lambda, \quad (3)$$

where ρ_m, ρ_Λ are the energy densities of matter and the holographic dark energy respectively and p_Λ is the pressure of the holographic dark energy.

The holographic dark energy density is given by

$$\rho_\lambda = 3(\alpha H^2 + \beta \dot{H}) \quad (4)$$

i.e. $\rho_\lambda = 3(\alpha H^2 + \beta \dot{H})$ with $M_p^{-2} = 8\pi G = 1$ (Granda & Oliveros [23]).

where H is a Hubble parameter.

For a universe where dark energy and dark matter are interacting to each other the total energy density $(\rho = \rho_m + \rho_\lambda)$ satisfies the continuity equation as following

$$\dot{\rho}_m + \dot{\rho}_\lambda + 3H(\rho_m + \rho_\lambda + p_\lambda) = 0 \quad (5)$$

Now, we considered the interaction between dark energy and dark matter. So, they do not conserve separately. The equation of continuity of matter is

$$\dot{\rho}_m + 3H\rho_m = Q \quad (6)$$

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The equation of continuity of holographic dark energy is

$$\dot{\rho}_\Lambda + 3H(1+\omega)\rho_\Lambda = -Q \tag{7}$$

where Q represents the interaction between dark matter and dark energy.

In general Q should be a function with units of inverse of time. For convenience we choose $Q = 3\delta H\rho_m$ [24] where δ is the coupling constant. On putting $\delta = 0$ the equation of continuity reduces to the non-interacting case.

Using equation (4) and putting $Q = 3\delta H\rho_m$ in equation (7), it is found that

$$\omega_\Lambda = -1 - \frac{2\alpha H\dot{H} + \beta\ddot{H}}{3H(\alpha H^2 + \beta\dot{H})} - \delta\frac{\rho_m}{\rho_\Lambda}. \tag{8}$$

The average scale factor a for Bianchi type-III defined as

$$a = (a_1 a_2 a_3)^{1/3}. \tag{9}$$

The volume scale factor V is given by

$$V = a^3 = a_1 a_2 a_3. \tag{10}$$

The generalized mean Hubble parameter defined as

$$H = \frac{1}{3}\left[H_x + H_y + H_z\right], \tag{11}$$

where $H_x = \frac{\dot{a}_1}{a_1}$, $H_y = \frac{\dot{a}_2}{a_2}$ and $H_z = \frac{\dot{a}_3}{a_3}$ are directional Hubble's factor in the direction x, y and z respectively. A overhead dot $(\dot{})$ denotes differentiation with respect to time t.

From equation (9) to (11), we obtain

$$H = \frac{1}{3}\frac{\dot{V}}{V} = \frac{\dot{a}}{a} = \frac{1}{3}\left(\frac{\dot{a}_1}{a_1} + \frac{\dot{a}_2}{a_2} + \frac{\dot{a}_3}{a_3}\right). \tag{12}$$

The Einstein's field equations (2), for the metric (1), with the help of equation (3) given by

$$\frac{\ddot{a}_2}{a_2}+\frac{\ddot{a}_3}{a_3}+\frac{\dot{a}_2\dot{a}_3}{a_2a_3}=-p_\Lambda; \tag{13}$$

$$\frac{\ddot{a}_1}{a_1}+\frac{\ddot{a}_3}{a_3}+\frac{\dot{a}_1\dot{a}_3}{a_1a_3}=-p_\Lambda; \tag{14}$$

$$\frac{\ddot{a}_1}{a_1}+\frac{\ddot{a}_2}{a_2}+\frac{\dot{a}_1\dot{a}_2}{a_1a_2}-\frac{m^2}{a_1^2}=-p_\Lambda; \tag{15}$$

$$\frac{\dot{a}_1\dot{a}_2}{a_1a_2}+\frac{\dot{a}_2\dot{a}_3}{a_2a_3}+\frac{\dot{a}_1\dot{a}_3}{a_1a_3}-\frac{m^2}{a_1^2}=\rho_m+\rho_\Lambda; \tag{16}$$

$$m\left(\frac{\dot{a}_1}{a_1}-\frac{\dot{a}_2}{a_2}\right)=0; \tag{17}$$

Equation (17) obviously leads to

$$a_2=c_1a_1;$$

(18)where μ is an integration constant.

Using equation (18), field equations (13) to (17) reduces to

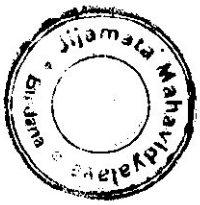
$$\frac{\ddot{a}_1}{a_1}+\frac{\ddot{a}_3}{a_3}+\frac{\dot{a}_1\dot{a}_3}{a_1a_3}=-p_\Lambda; \tag{19}$$

$$2\frac{\ddot{a}_1}{a_1}+\frac{\dot{a}_1^2}{a_1^2}-\frac{m^2}{a_1^2}=-p_\Lambda; \tag{20}$$

$$\frac{\dot{a}_1^2}{a_1^2}+2\frac{\dot{a}_1\dot{c}_3}{a_1a_3}-\frac{m^2}{a_1^2}=\rho_m+\rho_\Lambda. \tag{21}$$

Solution of the Field Equations:

The field equations (19) to (21) is a system of three equations with five unknown parameters $a_1, a_3, \rho_m, \rho_\Lambda$ and p_Λ. In order to obtain an explicit solution of system we need two additional constraints.



We consider recent work of Akarsu et al.[25]

$$a(t) = a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}, \tag{22}$$

where γ and ξ are non-negative constants and a_0 and t_0 represents the present value of scale factor and age of the universe respectively. The Hybrid Expansion Law (HEL) is a combination of a power law and an exponential function. It is observed that $\gamma = 0$ gives the exponential law cosmology while $\xi = 0$ gives power law cosmology.

Secondly, we assume that the scalar expansion (θ) in the models is proportional to the shear scalar (σ^2). This condition leads to

$$a_3 = a_1^n, \qquad \text{where } n \text{ is a constant} \tag{23}$$

Using equations (2), (18), (22) and (23), we can find the metric components as

$$a_1(t) = \left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{3}{n+2}}, \tag{24}$$

$$a_2(t) = c_1\left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{3}{n+2}}, \tag{25}$$

$$a_3(t) = \left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{3n}{n+2}}. \tag{26}$$

Using equations (24) to (26), the differential Hubble parameters found as

$$H_x = H_y = \frac{3}{n+2}\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right), \tag{27}$$

$$H_z = \frac{3n}{n+2}\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right). \tag{28}$$

The Hubble parameter is given by

$$H = \frac{1}{3}\frac{\dot{V}}{V} = \frac{1}{3}\left[H_x + H_y + H_z\right] = \frac{\gamma}{t} + \frac{\xi}{t_0} \tag{29}$$

Using equations (8) and (10), the holographic dark energy density (ρ_Λ) and dark matter energy density (ρ_m) obtained as

$$\rho_\Lambda = \frac{3\alpha(\xi t + \gamma t_0)^2 - 3\beta\gamma t_0^2}{t^2 t_0^2} \tag{30}$$

$$\rho_m = c_2\left[a_0\left(\frac{t}{t_0}\right)^\gamma e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{-3(1-\delta)} \tag{31}$$

The coincident parameter (μ) which is the ratio of the holographic dark energy density (ρ_Λ) and dark matter energy density (ρ_m) obtained as

$$\mu = \frac{\rho_\Lambda}{\rho_m} = \frac{3\alpha(\xi t + \gamma t_0)^2 - 3\beta t_0^2}{c_2 t^2 t_0^2\left[a_0\left(\frac{t}{t_0}\right)^\gamma e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{-3(1-\delta)}} \tag{32}$$

The expression for EoS parameter (ω_Λ) as follows

$$\omega_\Lambda = -1 - \frac{\frac{2\beta\gamma}{t^3} - \left(\frac{\gamma}{t}+\frac{\xi}{t_0}\right)\left[\frac{2\alpha\gamma}{t^2} - \delta c_2\left(a_0\left(\frac{t}{t_0}\right)^\gamma e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)}\right]}{3\left(\frac{\gamma}{t}+\frac{\xi}{t_0}\right)\left[\alpha\left(\frac{\gamma}{t}+\frac{\xi}{t_0}\right)^2 - \frac{\beta\gamma}{t^2}\right]} \tag{33}$$

4. Correspondence between Holographic and Polytropic gas model of dark energy:

The equation of state parameter of polytropic gas is given by

$$p_{p\xi} = K\rho_{p\xi}^{1+\frac{1}{\eta}}, \tag{34}$$

where K and η are the polytropic constant and the polytropic index respectively [26].

The energy density of polytropic gas is defined as

$$\rho_{ps} = (Ba^{\frac{3}{\eta}} - K)^{-\eta}, \tag{35}$$

where B is the positive constant of integration and a is the scale factor. It can be seen that the polytropic index η should be even to positive energy density.

Using equations (34) and (35), we find the EoS parameter as

$$\omega_{ps} = \frac{p_{ps}}{\rho_{ps}} = -1 - \frac{Ba^{\frac{3}{\eta}}}{K - Ba^{\frac{3}{\eta}}}, \tag{36}$$

If polytropic gas is treated as an ordinary scalar field then the energy density and pressure of the scalar field are given by

$$\rho_\phi = \frac{\dot{\phi}^2}{2} + V(\phi) \tag{37}$$

$$p_\phi = \frac{\dot{\phi}^2}{2} - V(\phi) \tag{38}$$

where dot denotes the derivative with respect to cosmic time t.

Thus using equations (34), (35), (37) and (38), we obtained the scalar potential and the kinetic energy term for the polytropic gas model as

$$V(\phi) = \frac{\frac{1}{2}Ba^{\frac{3}{\eta}} - K}{(Ba^{\frac{3}{\eta}} - K)^{\eta+1}} \tag{39}$$

$$\dot{\phi}^2 = -\frac{Ba^{\frac{3}{\eta}}}{(Ba^{\frac{3}{\eta}} - K)^{\eta+1}} \tag{40}$$

To establish the correspondence between the holographic dark energy with polytropic gas dark energy model, we compare the holographic dark energy with the energy density of polytropic gas model and also equate the EoS parameter of both the models. We assume that the holographic dark energy density is equivalent to the energy density of polytropic gas. Equating equations (30) and (35), we get

$$\rho_h = \frac{3\alpha(\xi t + \gamma t_0)^2 - 3\beta\gamma t_0^2}{t^2 t_0^2} = (Ba^{\frac{3}{\eta}} - K)^{-\eta}. \quad (41)$$

Also, comparing equations (33) and (36), we have

$$\omega_h = -1 - \frac{\frac{2\beta\gamma}{t^3} - \left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)\left[\frac{2\alpha\gamma}{t^2} - \delta c_2\left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)}\right]}{3\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)\left[\alpha\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^2 - \frac{\beta\gamma}{t^2}\right]} = -1 - \frac{Ba^{\frac{3}{\eta}}}{K - Ba^{\frac{3}{\eta}}}. \quad (42)$$

From equations (41) and (42), we get

$$B = \left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-\frac{3}{\eta}} \left[\frac{\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)\left[\frac{2\alpha\gamma}{t^2} - \delta c_2\left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)}\right] - \frac{2\beta\gamma}{t^3}}{\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)\left[3\alpha\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^2 - \frac{3\beta\gamma}{t^2}\right]^{1+\frac{1}{\eta}}}\right] \quad (43)$$

and

$$K = \frac{\frac{\gamma(2\alpha+3\beta)}{t^2} - 3\alpha\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^2 - \frac{2\beta\gamma}{t^3}\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^{-1} - \delta c_2\left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)}}{\left[3\alpha\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^2 - \frac{3\beta\gamma}{t^2}\right]^{-1-\frac{1}{\eta}}} \quad (44)$$

On using equations (39), (40), (43) and (44), the kinetic energy term and the potential of the polytropic gas dark energy model can be obtained as

$$\phi = \int\left[\frac{2\alpha\gamma}{t^2} - \frac{2\beta\gamma}{t^3}\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^{-1} - \delta c_2\left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)}\right]^{-1} dt \quad (45)$$

$$V(\phi) = 3\alpha\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^2 + \frac{\beta\gamma}{t^3}\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right)^{-1} - \frac{\gamma(\alpha+3\beta)}{t^2} + \frac{1}{2}\left(a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t}-1\right)}\right)^{-3(1-\delta)} \quad (46)$$

This type of potential can produce an accelerated expansion of the universe.

Physical Aspects of the Model:

The cosmological model using equation (24) to (26) in equation (1) written as

$$ds^2 = dt^2 - \left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{6}{n+2}} dx^2 - \left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{6}{n+2}} e^{-2mx} dy^2 - \left[a_0 c_1^{-\frac{1}{3}}\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^{\frac{6n}{n+2}} dz^2 \quad (47)$$

The physical parameters of model (47) such as Spatial volume (V), Expansion scalar (θ), Mean anisotropic parameter (Δ), Shear scalar (σ^2), Deceleration parameter (q) are defined as

$$V = \left[a_0\left(\frac{t}{t_0}\right)^{\gamma} e^{\xi\left(\frac{t}{t_0}-1\right)}\right]^3, \quad (48)$$

$$\theta = 3H = 3\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right), \quad (49)$$

$$\Delta = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 = 2\left(\frac{n-1}{n+2}\right)^2, \quad (50)$$

$$\sigma^2 = \frac{3}{2}\Delta H^2 = 3\left(\frac{n-1}{2n+1}\right)^2\left(\frac{\gamma}{t} + \frac{\xi}{t_0}\right), \quad (51)$$

$$q = -1 + \frac{\gamma t_0^{\,2}}{(\xi t + \gamma t_0)^2}, \quad (52)$$

$n > 0$ and $n \neq 1$.

Conclusion:

It is observed that at time , the scale factors and the spatial volume vanishes exhibiting point type singularity. Further at , the spatial volume . Therefore the universe evolves with a zero volume and expands infinity for large values of . The Hubble parameter, Expansion scalar, and Shear scalar diverge at time . The deceleration parameter is positive at early stage of the universe and become negative at late time representing that the model gives the transition from a decelerating expansion phase to the accelerating phase of the universe. We observed that the mean anisotropy parameter is constant throughout the evolution. Also ,which implies that our model is anisotropic at all-time except when . The dark matter and dark energy densities decreases as universe expands. The coincidence parameter is an increasing function of time and closure to the value 2.33 obtained as the recent observational data (Ade et al.[27]). The EoS parameter is decreasing rapidly till present age of the universe and approaches ?1 asymptotically in the future universe representing a ?CDM model for the future evolution of the universe. The corresponding between the holographic dark energy and the polytropic gas model of dark energy has been established. It is interesting to note that our model is analogues in all respects with the model obtained by Rehman & Ansari[18].

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KANTOWSKI-SACH BOUNCING COSMOLOGICAL MODEL WITH VISCOUS FLUIDS

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ABSTRACT

The bounce in viscous fluid cosmology with inhomogeneous viscous fluids in Kantowski space-time has been investigated by considering different forms of scale factor. The general features of the fluids which realize them and the possibility to have an acceleration after the bounce have been discussed.

Keywords:Kantowski-SachSpace Time. Viscous Fluid. Energy Conditions

INTRODUCTION

Observational evidence point towards an accelerated expansion of the universe. The astrophysical observations of the SN₁a (Perlmutter*et al.*1999), cosmic microwave Radiation (Bennet*et al.* 2003; Spergel*et al.*2003), X-ray (Allen *et al.*2004), are the main evidences for the cosmic acceleration. For this acceleration expansion of the universe a new energy with negative pressure is driven which is commonly known as dark energy (DE). (Peebles and Ratra 2003). Dark energy is major component in energy field of the universe (Ade *et al.* 2013). The dark energy which is responsible for accelerated expansion of the universe has been captured a vast range of recherché in astrophysics. But till now the nature of dark energy is a challenging problem in theoretical physics.

The observations also indicate that the fluids in the universe is not a perfect fluids (Jaffe *et al.* 2005) and the viscosity plays role in the evolution of the universe (Brevik and Gorbunova 2005, Brevik*et al* 2005. Cataldo*et al.* 2005). Several interesting cosmological solutions with a variety of features obtain by considering the contain of the universe different from standard matter. Among them, the bounce, solutions (where the contraction is followed by an expansion at a finite time) are quite interesting (Novello and Bergliatta 2008, Battefeld and Peter 2015). In the matter bounce scenarios the initial contraction of the universe is in matter dominated stage, after that a universe without initial singularity appears leading to an expanding universe. In the context of bouncing cosmology, inclusion of viscosity Broadens the applicability of the considered theory.

Many different aspects of bounce cosmology have been analyzed in the literature (Belinsky*et al.* 1970). For BKL instability; Khoury*et al.* (2001) for the Ekpyrotic scenario, Piao*et al.* (2004), Lin etc (2013) for the conformation of the bounce universe with planck observation. (Bamba*et al.* 2014) have investigated bounce solutions in the framework of modified gravity and massive bi-gravity.

The aim of this work is to investigate the bounce cosmology induced by inhomogeneous viscous fluids in Kantowski-Sach space time. We will discuss different bounce solutions and the features of the related viscous fluids, taking into account the necessity to have a cosmic (inflationary) acceleration after the bounce. In particular, we are interested in the relation between bounce and singular solutions and in the corresponding relation between the viscous fluids realizing such a scenario.

The paper is organized as follows. In section 2, the formalism of inhomogeneous viscous fluid in Kantowski-Sach universe is presented. In section 3, we will analyze the bounce solutions in fluids cosmology. In section 4, the same investigations will be carried out for the bounce solutions, conclusions and remarks are given in section 5.

METRIC AND FIELD EQUATIONS

Kantowski-Sach space time is considered in the form

$$ds^2 = dt^2 - A^2 dr^2 - B^2\left(d\theta^2 + \sin^2\theta d\phi^2\right), \quad (1)$$

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where A and B are scale factors and are functions of cosmic time t.

The energy-momentum tensor for the viscous fluid is given by

$$T_{ij} = \rho u_i u_j + p(u_i u_j - g_{ij}) \,, \qquad (2)$$

where u_i are the co-moving four velocity vectors, ρ is the energy density and g_{ij} is the metric tensor.

The fluid in the universe is inhomogeneous viscous fluid with equation of state (Nojjiri and Odintsov 2005, 2006; Capozziello*et al.* 2006)

$$p = \gamma(\rho)\rho - B(a, H, \dot{H}, ...), \qquad (3)$$

where the equation of state parameter γ may depend on ρ and bulk viscosity B is a general function of a, H and its derivatives. a is the average scale factor.

Using equations (2) and (3), the energy-momentum tensor for the viscous fluid is

$$T_{ij} = \rho u_i u_j + (\gamma(\rho)\rho + B(\rho, H, \dot{H}, ...))(u_i u_j - g_{ij}) \,. \qquad (4)$$

The Einstein's field equations in general theory of gravitation are,

$$R^i_j - \frac{1}{2} R g^i_j = -T^i_j \,. \qquad (5)$$

With the help of equation (4), the field equations (5) for the metric (1) are

$$2\frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} + \frac{1}{B^2} = \rho \,, \qquad (6)$$

$$2\frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{1}{B^2} = -p \,, \qquad (7)$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} = -p \,, \qquad (8)$$

where an overhead dot $\left(\dot{\ }\right)$ represents differentiation with respect to t.

The energy-conservation equation, which is the consequence of the field equations (5)is given by,

$$T^{ij}_{;j} = 0 \,,$$

where,

$$T^{ij}_{;j} = \frac{1}{\sqrt{-g}} \frac{\partial}{\partial x^j}\left(T^{ij}\sqrt{-g}\right) + T^{jk}\Gamma^i_{jk}$$

which simplifies to

$$\dot{\rho} + 3H(\rho + p) = 0 \,. \qquad (9)$$

Using equation (3), equation (9) reduces to

$$\dot{\rho} + 3H(1 + \gamma(\rho))\rho = 3HB(\rho; a, H, \dot{H}.....) \qquad (10)$$

From the thermodynamic point of view, for positive entropy change in an irreversible process, the bulk viscosity must be a positive quantity (Brevik&Gorbunov 2005, Brevik&Gorbunov*et al.* 2006). The cosmological parameter Ω is defined as:

$$\Omega = 1 + \frac{1}{a^2 H^2} \,. \qquad (11)$$

The quantity Ω in general may be different from(1).

By a bouncing universe, we mean a universe that undergoes a collapse, attains a minimum and then subsequently expands. For a successful bounce in Kantowski–Sachmodel, during contraction phase $a(t)$ is decreasing i.e. $(\dot{a}(t) < 0)$ and then in the expanding phase, the scale factor is increasing i.e. $(\dot{a}(t) > 0)$. At the bounce point i.e. at $t = t_b$, the minimal necessary condition is

i) $\dot{a}(t_b) = 0$ and

ii) $\ddot{a}(t) > 0$ for $t \in (t_b - \epsilon, t_b) \cup (t_b, t_b + \epsilon)$, for small $\epsilon > 0$.

For a non-singular bounce $a(t_b) \neq 0$. These conditions may not be sufficient for a non-singular bounce.

The bounce behaviour of cosmological model is also realized using energy conditions as mentioned in Paris&Visser (1999); Singh &Chaubeye*t al.* 2016). In terms of (3) and(4), energy conditions can be stated as:

Null Energy Condition (NEC) is satisfied when $\rho + p \geq 0$.

Weak Energy Condition (WEC) is satisfied when $\rho \geq 0$ and $\rho + p \geq 0$.

Dominant Energy Condition (DEC) is satisfied when $\rho \geq |p|$.

Strong Energy Condition (SEC) is satisfied when $\rho + p \geq 0$ and $\rho + 3p \geq 0$ It is clear that, violation of NEC will lead to a violation of other energy conditions. (i.e. SEC) realizing the bounce.

SOLUTION OF FIELD EQUATIONS

The field equations (6) to (8) are a system of three highly nonlinear differential equations in four unknowns A, B, ρ and γ. The system is thus initially undetermined. We need one extra condition for solving the field equations completely. We assume that the scalar expansion

(θ) is proportional to shear (σ). This condition leads to

$$\frac{1}{\sqrt{3}}\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right) = \alpha_0\left(\frac{\dot{A}}{A}+2\frac{\dot{B}}{B}\right),$$

which yields

Above equation after integration reduces to

$$A = \eta(B)^m,$$

where η is an integration constant

Here, for simplicity and without loss generality, we assume that $\eta = 1$.

Hence, we have

$$A=(B)^m, (m\neq 1), \tag{12}$$

Collins *et al* have pointed out that for spatially homogenous metric, thenormal congruence to the homogenous expansion satisfies that the condition $\frac{\sigma}{\theta}$ is constant (Collins 1980).

CASE I : FLUID MODEL WITH $a(t) = \sqrt{a_0^2 + \beta^2 t^2}$:

The bouncing cosmological model has been obtained by choosing the average scale factor $a(t)$ of the form (Paris & Visser,1999)

$$a(t) = \sqrt{a_0^2 + \beta^2 t^2}, \tag{13}$$

where a_0, β are non-zero positive constants.

The above scale factor is the temporal analogue of the toy model traversable wormhole (Morris & Thorne 1988). One may get phenomenological quintom bouncing model with proper renormalization of a_0, β(Cai*et al.* 2007).

The Hubble parameter is given by

$$H(t) = \frac{\dot{a}}{a} = \frac{\beta^2 t}{a_0^2 + \beta^2 t^2}. \tag{14}$$

In terms of geometrical quantities, we have

$$\frac{\ddot{a}}{a} = \dot{H} + H^2 = \frac{(\beta a_0)^2}{(a_0^2 + \beta^2 t^2)^2}. \tag{15}$$

For the metric (1), the average scale factor is given by

$$a(t) = (AB^2)^{\frac{1}{3}}. \tag{16}$$

From the equations (13)and(16), we have

$$AB^2 = \left(a_0^2 + \beta^2 t^2\right)^2. \tag{17}$$

Using equation(14), (16) reduces to

$$B = \left(a_0^2 + \beta^2 t^2\right)^{\frac{3}{2(m+2)}}. \tag{18}$$

Using equation(18), equation (12) leads to

$$A = \left(a_0^2 + \beta^2 t^2\right)^{\frac{3m}{2(m+2)}}. \tag{19}$$

With the help of equations (18)and(19), the metric (1) becomes

$$ds^2 = dt^2 - (a_0^2+\beta^2 t^2)^{\frac{3m}{m+2}} dr^2 - (a_0^2+\beta^2 t^2)^{\frac{3}{m+2}}(d\theta^2 + \sin^2\theta d\phi^2). \tag{20}$$

Equation(20) represents Kantowski-Sach bouncing cosmological model with the viscous fluid in general theory of relativity.

4.1 SOME PHYSICAL PROPERTIES OF THE MODEL

For the cosmological model (20), the physical quantities such as spatial volume V, Hubble parameter H, expansion scalar θ, mean anisotropy A_m,shear scalar σ^2, energy density ρ are obtained as follows:

The spatial volume is in the form

$$V = a^3 = (a_0^2 + \beta^2 t^2)^{\frac{3}{2}}. \tag{21}$$

The Hubble parameter is

$$H = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right) = \frac{\beta^2 t}{a_0^2 + \beta^2 t^2}. \tag{22}$$

The expansion scalar is

$$\theta = 3H = \frac{3\beta^2 t}{a_0^2 + \beta^2 t^2}. \tag{23}$$

The mean anisotropy parameter A_m is

$$A_m = \frac{2(m-1)^2}{(m+2)^2} = const. \neq 0, \quad \text{for } m \neq 1. \tag{24}$$

The shear scalar is

$$\sigma^2 = \frac{3(m-1)^2 \beta^4 t^2}{(m+2)^2 (a_0^2 + \beta^2 t^2)^2}. \tag{25}$$

It is observed that

$$\lim_{t\to\infty} \frac{\sigma^2}{\theta^2} = \frac{1}{3}\frac{(m-1)^2}{(m+2)^2} \neq 0, \quad \text{for } m \neq 1. \tag{26}$$

The mean anisotropy parameter A_m and $\lim_{t\to\infty} \frac{\sigma^2}{\theta^2} \neq 0$ is constant. Hence the model is anisotropic throughout the evolution of the universe, except at $m = 1$ (i.e. the model does not approach isotropy).

The matter-energy density is given by

$$\rho = \frac{9(m+2)\beta^4 t^2}{(m+2)^2(a_0^2+\beta^2 t^2)^2} + \frac{1}{(a_0^2+\beta^2 t^2)^{\frac{3}{m+2}}}, \quad (27)$$

$$\rho + p = \frac{6(5m+1)\beta^4 t^2}{(m+2)^2(a_0^2+\beta^2 t^2)^2} - \frac{6\beta^2}{(m+2)(a_0^2+\beta^2 t^2)} \quad (28)$$

$$\rho - p = 2\left[\frac{9}{(m+2)}(a_0^2+\beta^2 t^2)^{-2} - \frac{6\beta^2}{(m+2)}(a_0^2+\beta^2 t^2)^{-2} + (a_0^2+\beta^2 t^2)^{\frac{-3}{(m+2)}}\right] \quad (29)$$

$$\rho + 3p = \frac{54m\beta^4 t^2}{(m+2)^2(a_0^2+\beta^2 t^2)^2} - \frac{18\beta^2}{(m+2)(a_0^2+\beta^2 t^2)} - \frac{2}{(a_0^2+\beta^2 t^2)^{\frac{3}{m+2}}} \quad (30)$$

The cosmological parameter for the closed universe takes the form,

$$\Omega = 1 + \frac{1}{a^2 H^2},$$

$$\Omega = 1 + \frac{1}{\beta^2} + \frac{a_0^2}{\beta^4 t^2} \quad (31)$$

The bulk viscosity is

$$B(a,H,\dot{H}.....) = 3H\zeta \quad (32)$$

In this specific case, equation(3) takes the form

$$p = -\rho + 3H\zeta \quad (33)$$

From equation (28), we have

$$3H\zeta = \frac{6(5m+1)H^2}{(m+2)^2} - \frac{6\beta^2}{(m+2)a^3}$$

Dividing by $3H$

$$\zeta(H,a) = \frac{2(5m+1)H}{(m+2)^2} - \frac{2\beta^2}{(m+2)Ha^2}. \quad (34)$$

In equation (33), When the scale factor becomes large, $\zeta(H) \approx \frac{2(5m+1)H}{(m+2)^2}$ and then we can treat it as a fluid with a bulk viscosity of $\zeta(H)$. Therefore, with $\zeta(H,a)$, we can recognize bouncing universe with the scale factor (13).

In another example, we take $\gamma(\rho) = \gamma$ (constant) and $B(\rho,a,H,\dot{H}.....) = 4H\zeta$ with $\zeta = \epsilon\rho$, where ϵ is constant.

Using equation (9), we have

$$\dot{\rho} = -3H(\rho + p)$$

Using equation (3), we get

$$\dot{\rho} = -3H\left(\gamma(\rho)\rho - B(a,H,\dot{H},.....)\right)$$

Since, $\zeta = \epsilon\rho$ and $B(a,H,\dot{H},.....) = 3H\zeta$, we have

$$\rho = \frac{a_1}{(a_0^2+\beta^2 t^2)^{\frac{3(1+\gamma-\epsilon)}{2}}}$$

where, a_1 is a constant of integration.

Also, from equation (3) we get

$$p = \gamma(\rho)\rho - B(a,H,\dot{H},.....)$$

Using $\gamma(\rho) = \gamma = \text{Constant}$, and $B(a,H,\dot{H},.....) = 3H\zeta$ we get

$$p = (\gamma - 3H\epsilon)\rho. \quad (35)$$

The scenario with $\gamma = \text{constant}$, $\zeta = \epsilon\rho$ the energy density of the bouncing universe will decrease with increasing time (provided, $(1+\gamma > \epsilon)$) and also the bulk viscosity. For the large time t, p will become negative.

Fig. 5.1 represents the plots of time versus (a) Average scale factor (b) Hubble parameter (c) Energy density (ρ) (d) $\rho + p$ (e) $\rho - p$ (f) $\rho + 3p$

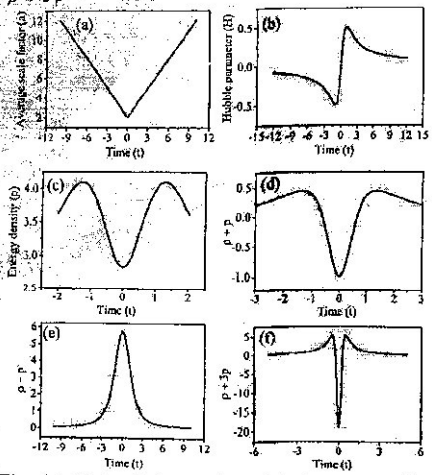

Fig. 4.1 Plots of time versus (a) Average scale factor (b) Hubble parameter (c) Energy density (ρ) (d) $\rho + p$ (e) $\rho - p$ (f) $\rho + 3p$

DISCUSSION

Fig. (4.1) (a) is the plot of time versus average scale factor. It is seen that, during contraction phase, the average scale factor $a(t)$ is decreasing (i.e. $\dot{a}(t) < 0$) and then in the expanding phase $a(t)$ is increasing (i.e. $\dot{a}(t) > 0$). Hence, the minimal necessary conditions (i) and (ii) for the bounce at time $t = 0$ are satisfied (Singh &Chaubey 2016).

(i) $\dot{a}(t) = 0$ at $t = 0$

and (ii) at $t = 0$, $\ddot{a}(t) > 0$ for $t \in (0-\epsilon, 0) \cup (0, 0+\epsilon)$, where ϵ is very small.

Fig. (4.1) (b) is the plot of time versus Hubble parameter. At $t = 0$, we get $H = 0$ and $a(0) = a_0$ with $\dot{H}(t) > 0$ in small neighborhoodof $t = 0$, provided $a_0 > \beta$. Thus it satisfies the necessary condition of bounce (Singh*et al.* 2015a, 2015b). After the bounce, the universe expands in an accelerated way.

To realize the bounce in our model, let we obtain the values of ρ, $\rho + p$, $\rho - p$ and $\rho + 3p$ for $m = 2$.

$$\rho = (2.25)\beta^4 t^2 (a_0^2 + \beta^2 t^2)^{-2} + (a_0^2 + \beta^2 t^2)^{-\frac{3}{4}},$$

$$\rho + p = (4.12)\beta^2 t^2 (a_0^2 + \beta^2 t^2)^{-2} - (1.5)\beta^2 (a_0^2 + \beta^2 t^2)^{-1},$$

$$\rho - p = (4.8)(a_0^2 + \beta^2 t^2)^{-2} - 3\beta^4 t^2 (a_0^2 + \beta^2 t^2)^{-2} + 2(a_0^2 + \beta^2 t^2)^{-(0.75)},$$

$$\rho + 3p = (6.75)\beta^4 t^2 (a_0^2 + \beta^2 t^2)^{-2} - (4.5)\beta^2 (a_0^2 + \beta^2 t^2)^{-1} - 2(a_0^2 + \beta^2 t^2)^{-(0.75)}$$

From Fig. (5.1) (c), (d), (e) and (f) are the plots of time versus energy density (ρ), $\rho + p$, $\rho - p$ and $\rho + 3p$. It is observed that WEC, NEC and DEC energy conditions are satisfied at $t = 0$ but SEC is violated at $t = 0$. Hence, the bounce is realized in our model at $m = 2$

5. CASE II : FLUID MODEL WITH SCALE FACTOR $a(t) = a_1(e^{\alpha t} + e^{-\alpha t})$

The bouncing cosmological model has been obtained by choosing the average scale factor $a(t)$ of the form (Bamba*et al.* 2014)

$$a(t) = a_1(e^{\alpha t} + e^{-\alpha t}), \qquad (36)$$

where a_1, β are non-zero positive constants.

The Hubble parameter is given by

$$H(t) = \frac{\dot{a}}{a} = \frac{\alpha(e^{\alpha t} - e^{-\alpha t})}{(e^{\alpha t} + e^{-\alpha t})}. \qquad (37)$$

For the metric(1), the average scale factor is given by

$$a(t) = (AB^2)^{\frac{1}{3}}. \qquad (38)$$

From the equations (36) and (38) we have

$$AB^2 = a_1^3(e^{\alpha t} + e^{-\alpha t})^3 \qquad (39)$$

With the help of equation(12), equation (39) reduces to

$$B = a_1^{\frac{3}{m+2}}(e^{\alpha t} + e^{-\alpha t})^{\frac{3}{m+2}}. \qquad (40)$$

With the help of equation (40), equation (12) leads to

$$A = a_1^{\frac{3m}{m+2}}(e^{\alpha t} + e^{-\alpha t})^{\frac{3m}{m+2}}. \qquad (41)$$

With the help of equations (40) and (41), the metric (1) can be written as

$$ds^2 = dt^2 - a_1^{\frac{6m}{m+2}}(e^{\alpha t} + e^{-\alpha t})^{\frac{6m}{m+2}}dr^2 - a_1^{\frac{6}{m+2}}(e^{\alpha t} + e^{-\alpha t})^{\frac{6}{m+2}}(d\theta^2 + \sin^2\theta d\phi^2) \qquad (42)$$

The equation(42)represents Kantowski-Sachs cosmological model with viscous fluid in general theory of relativity.

5.1 SOME PHYSICAL PROPERTIES OF THE MODEL :

For the cosmological model (42), the physical quantity such as spatial volume V, Hubble parameter H, expansion scalar θ, mean anisotropy A_m, shear scalar σ^2 energy density ρ, are obtained as follows.

The spatial volume is in the form

$$V = a_1^3(e^{\alpha t} + e^{-\alpha t})^3. \qquad (43)$$

The Hubble parameter is

$$H = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right) = \frac{\alpha(e^{\alpha t} - e^{-\alpha t})}{(e^{\alpha t} + e^{-\alpha t})}. \qquad (44)$$

The expansion scalar is given by

$$\theta = 3H = \frac{3\alpha(e^{\alpha t} - e^{-\alpha t})}{(e^{\alpha t} + e^{-\alpha t})}. \qquad (45)$$

The mean anisotropy parameter is given by

$$A_m = \frac{2(m-1)^2}{(m+2)^2} = \text{constant} \neq 0, \text{ for } m \neq 1. \qquad (46)$$

The shear scalar is

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$$\sigma^2 = \frac{3\alpha^2(m-1)^2}{(m+2)^2}\frac{(e^{\alpha t}-e^{-\alpha t})^2}{(e^{\alpha t}+e^{-\alpha t})^2}. \quad (47)$$

It is observed that

$$\lim_{t\to\infty}\frac{\sigma^2}{\theta^2} = \frac{1}{3}\frac{(m-1)^2}{(m+2)^2} = \text{constant} \neq 0, \text{ for } m \neq 1. \quad (48)$$

The mean anisotropy parameter A_m is constant and $\lim_{t\to\infty}\frac{\sigma^2}{\theta^2} \neq 0$ is also constant. Hence the model is anisotropic throughout the evolution of the universe, except at $m = 1$ (i.e. the model does not approach isotropy).

The matter-energy density is given by

$$\rho = \frac{9\alpha^2(2m+1)}{(m+2)^2}\frac{(e^{\alpha t}-e^{-\alpha t})^2}{(e^{\alpha t}+e^{-\alpha t})^2} + a_1^{\frac{-6}{(m+2)^2}}(e^{\alpha t}+e^{-\alpha t})^{\frac{-6}{m+2}} \quad (49)$$

$$\rho + p = \frac{6\alpha^2(4m-1)}{(m+2)^2}\frac{(e^{\alpha t}-e^{-\alpha t})^2}{(e^{\alpha t}+e^{-\alpha t})^2} - \frac{6\alpha^2}{(m+2)}, \quad (50)$$

$$\rho - p = 2\left[\frac{6\alpha^2}{(m+2)}\frac{(e^{\alpha t}-e^{-\alpha t})^2}{(e^{\alpha t}+e^{-\alpha t})^2} + \frac{3\alpha^2}{(m+2)} + a_1^{\frac{-6}{(m+2)^2}}(e^{\alpha t}-e^{-\alpha t})^{\frac{-6}{m+2}}\right] \quad (51)$$

$$\rho + 3p = \frac{36\alpha^2(m-1)}{(m+2)^2}\frac{(e^{\alpha t}-e^{-\alpha t})^2}{(e^{\alpha t}+e^{-\alpha t})^2} - \frac{18\alpha^2}{(m+2)} + 2a_1^{\frac{-6}{(m+2)^2}}(e^{\alpha t}+e^{-\alpha t})^{\frac{-6}{m+2}} \quad (52)$$

Fig. 5.1 represents the plots of time versus (a) Average scale factor (b) Hubble parameter (c) Energy density (ρ) (d) $\rho + p$ (e) $\rho - p$ (f) $\rho + 3p$.

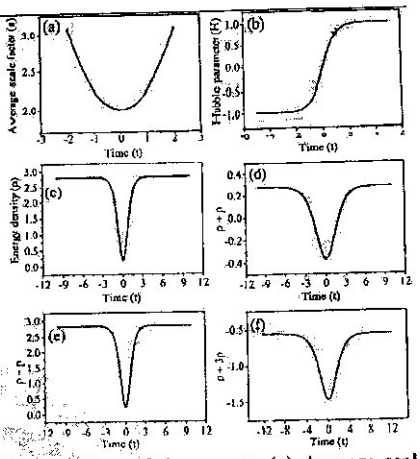

Fig. 5.1 Plots of time versus (a) Average scale factor (b) Hubble parameter (c) Energy density (ρ) (d) $\rho + p$ (e) $\rho - p$ (f) $\rho + 3p$.

The cosinological parameter for the closed universe takes the form:

$$\Omega = 1 + \frac{1}{a^2H^2}$$

$$\Omega = 1 + \frac{1}{a_1^2\alpha^3(e^{\alpha t}+e^{-\alpha t})^2}. \quad (53)$$

Discussion : Fig. (5.1) (a) is the plot of time versus average scale factor. It is seen that, during contraction phase, the average scale factor $a(t)$ is decreasing (i.e. $\dot{a}(t) < 0$) and then in the expanding phase $a(t)$ is increasing (i.e. $\dot{a}(t) > 0$) Hence, the minimal necessary conditions (i) and (ii) for the bounce at time $t = 0$ are satisfied (Singh *et al.* 2016).

(i) $\dot{a}(t) = 0$ at $t = 0$

and (ii) at $t = 0$, $\ddot{a}(t) > 0$ for $t \in (0-\epsilon, 0) \cup (0, 0+\epsilon)$, where ϵ is very small.

Fig. (5.1) (b) is the plot of time versus Hubble parameter. At the time $t = 0$, $H = 0$ and $a(0) = 2a_1$ with $\dot{H}(t) > 0$ in small neighborhood of $t = 0$. Therefore, the above scale factor satisfies necessary conditions for a non-singular bounce. With the above scale factor, we have $\ddot{a} > 0$ before and after the bounce (Singh *et al.* 2015 , 2015).

From Fig. (5.2) (c), (d), (e) and (f) are the plots of time versus energy density (ρ), $\rho + p$, $\rho - p$

and $\rho + 3p$. To realize the bounce in our model, let we obtain the values of ρ, $\rho + p$, $\rho - p$ and $\rho + 3p$ for $m = 2$.

$$\rho = (2.81)\alpha^2 \frac{(e^{\alpha t} - e^{-\alpha t})^2}{(e^{\alpha t} + e^{-\alpha t})^2} + a_1^{-(0.12)}(e^{\alpha t} + e^{-\alpha t})^{-(1.5)},$$

$$\rho + p = (2.62)\alpha^2 \frac{(e^{\alpha t} - e^{-\alpha t})^2}{(e^{\alpha t} + e^{-\alpha t})^2} - (1.5)\alpha^2,$$

$$\rho - p = 3\alpha^2 \frac{(e^{\alpha t} - e^{-\alpha t})^2}{(e^{\alpha t} + e^{-\alpha t})^2} + (1.5)\alpha^2 + 2a_1^{-(1.5)}(e^{\alpha t} + e^{-\alpha t})^{-(1.5)},$$

$$\rho + 3p = (2.25)\alpha^2 \frac{(e^{\alpha t} - e^{-\alpha t})^2}{(e^{\alpha t} + e^{-\alpha t})^2} - (4.5)\alpha^2 - 2a_1^{-(1.5)}(e^{\alpha t} + e^{-\alpha t})^{-(1.5)}.$$

It is observed that WEC, NEC and DEC energy conditions are satisfied at $t = 0$ but SEC is violated at $t = 0$. Hence, the bounce is realized in our model at $m = 2$.

As an example of viscous fluid realizing bounce scenario, we take $\gamma = -1$ and bulk viscosity is given by

$B(a, H, \dot{H}.....) = 3H\zeta$, ($\zeta$ being coefficient of bulk viscosity), we have

$$p = -\rho + 3H\zeta, \qquad (54)$$

From equation (50), we have

$3H\zeta = \rho + p$

$$= \frac{6(4m-1)H^2}{(m+2)^2} - \frac{6\alpha^2}{(m+2)}$$

Dividing by $3H$

$$\zeta(H) = \frac{2(4m-1)H}{(m+2)^2} - \frac{2\alpha^2}{(m+2)H}. \qquad (55)$$

As another example, we take $\gamma(\rho) = \gamma$ (constant) and $B(a, H, \dot{H}.....) = 3H\zeta$ with $\zeta = \epsilon\rho$, where ϵ is a constant.

From equation (9), we have

$$\dot{\rho} + 3H(\rho + p) = 0$$

$$\dot{\rho} = -3H(\rho + p).$$

Using equation (3) we get,

$$\dot{\rho} = -3H(\rho + p)$$

$$= -3H(\gamma(\rho)\rho - B(a, H, \dot{H}, ...))$$

Since, $\zeta = \epsilon\rho$ and $B(a, H, \dot{H}, ...) = 3H\zeta$, we have

$$\Rightarrow \quad \dot{\rho} = 3H\rho(\epsilon - (1 + \gamma))$$

$$\Rightarrow \quad \frac{\dot{\rho}}{\rho} = -3H(1 + \gamma - \epsilon).$$

Using equation (37), we get

$$\frac{\dot{\rho}}{\rho} = -3\left(\frac{\alpha(e^{\alpha t} - e^{-\alpha t})}{(e^{\alpha t} + e^{-\alpha t})}\right)(1 + \gamma - \epsilon).$$

Integrating with respect to t

$$\rho = \frac{\rho_0}{(e^{\alpha t} + e^{-\alpha t})^{3(1+\gamma-\epsilon)}}, \qquad (56)$$

where, ρ_0 is a constant.

Also, from equation (3) we get

$$p = \gamma(\rho)\rho - B(a, H, \dot{H}, ...). \qquad (57)$$

Using $\gamma(\rho) = \gamma =$ Constant and $B(a, H, \dot{H}, ...) = 3H\zeta$, we get $p = (\gamma - 3H\epsilon)\rho$.

Therefore, the scenario with γ = constant, $\zeta = \epsilon\rho$, the energy density of bouncing universe will decrease with increasing time (provided $1 + \gamma > \epsilon$).

CONCLUSIONS

Kantowski-Sach cosmological has been investigated with viscous fluid by considering two specific forms of the scale factors proposed by Molina-Parris and Visser, and Bamba*et al.* In both the cosmological models, it is realized that there is existence of bounce at point $t = 0$.

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Mathematics in Nature : Fibonacci Sequence

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Research Paper - Mathematics

ABSTRACT

In this it is introduced how Mathematics occur in nature.The well-known Fibonacci Sequence and corresponding Golden Angle appears in nature through branching of plants, arrangement of leaves so as to get optimum sunlight, air and to drain rain drops to roots.petals of flowers, arrangement of seed heads mostly follow terms related with Fibonacci Sequence.

Key words: Fibonacci numbers, Golden ratio, Spirals.

Introduction

There are many phenomena in the natural world in which mathematics occurs. These phenomena takes place at microscopic and also from galactic scales. But leaves , trees, spider webs, bubbles, waves, clouds, rainbows,.....these are things in nature we can see easily.

If we look down and around in a well-tended garden, we may see that arrangements of leaves, petals, seeds, and florets are intimately associated with spiral patterns. The related sequence of numbers 1 ,1 ,2 ,3 ,5 , 8 ,13 , 21 , 34 , 55 , 89 , 144 , ... which is the **Fibonacci Sequence** and also with an angle of about 137.5 (or its complement 222.5)which is known as **Golden Angle.** Spirals in three dimensions (helices) with interesting geometric properties plus striped patterns combine to make

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exquisite sea shells. Branching patterns in trees, leaves exhibit similar features.

2. FIBONACCI SEQUENCE

Fibonacci sequence is named after Leonardo of Pisa who was known as **FIBONACCI :**

(a contraction of fillius Bonaccii "son of Bonaccio") . Fibonacci's 1202 book Liber Abaci introduced the sequence to western European Mathematics, although the sequence had been previously described in Indian Mathematics. Pingala (200 BC),VIRAHANK (6 th Century),GOPALA (1135) and HEMCHANDRA described this sequence.

The Fibonacci Sequence is the sequence of numbers:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

The next number is found by adding up the two numbers before it.

The Rule to obtain n th term is

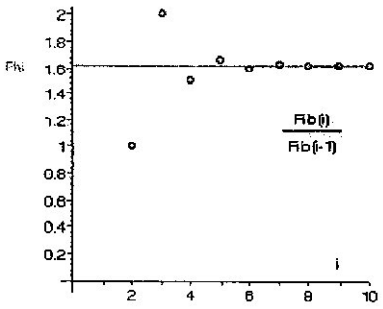
xn = xn-1 + xn-2 , n =3,4,5, ...

Fibonacci numbers and the Golden Number

If we take the ratio of two successive numbers in Fibonacci's sequence, (1, 1, 2, 3, 5, 8, 13, ..) and we divide each by the number before it, we will find the following series of numbers:

1/1 = 1, 2/1 = 2, 3/2 = 1·5, 5/3 = 1·666..., 8/5 = 1·6, 13/8 = 1·625, 21/13 = 1·61538...

It is easier to see what is happening if we plot the ratios on a graph:



The ratio seems to be settling down to a particular value, which we call **the golden ratio** or **the golden number**. It has a value of approximately **1·618034** , .

The **golden ratio** 1·618034 is also called the **golden section** or the **golden mean** or just the **golden number**. It is often represented by a Greek letter **Phi** ϕ.

To Calculate Fibonacci Numbers Using The Golden Ratio

And even more surprising is that we can **calculate any Fibonacci Number** using the

$$x_n = \frac{\varphi^n - (1-\varphi)^n}{\sqrt{5}}$$

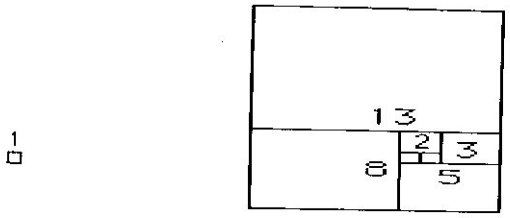
The answer always comes out **as a whole number**, exactly equal to the addition of the previous two terms.

$$x_6 = \frac{(1.618034...)^6 - (-0.618034...)^6}{\sqrt{5}} = 8$$

The number 8 is the 6 th term of Fibonnaci sequence.

3. FIBONACCI RECTANGLES AND SHELL SPIRALS

We can make another picture showing the Fibonacci numbers 1, 1, 2,3,5,8,13,21,.. if we start with two small squares of size 1 next to each other. On top of both of these draw a square of size 2 (=1+1).



We can now draw a new square - touching both a unit square and the latest square of side 2 - so having sides 3 units long; and then another touching both the 2-square and the 3-square (which has sides of 5 units). We can continue adding squares around the picture, **each new square having a side which is as long as the sum of**

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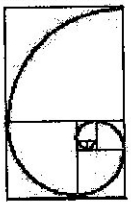
the latest two square's sides. This set of rectangles whose sides are two successive Fibonacci numbers in length and which are composed of squares with sides which are Fibonacci numbers, we will call the **Fibonacci Rectangles**.



Here is a spiral drawn in the squares, a quarter of a circle in each square. The spiral is not a *true* mathematical spiral (since it is made up of fragments which are parts of circles and does not go on getting smaller and smaller) but it is a good approximation to a kind of spiral that does appear often in nature. Such spirals are seen in the shape of shells of snails and sea shells and, as we see later, in the arrangement of seeds on flowering plants too. The spiral-in-the-squares makes a line from the centre of the spiral increase by a factor of the golden number in each square. So points on the spiral are 1.618 times as far from the centre after a quarter-turn. In a whole turn the points on a radius out from the centre are 1.6184 = 6.854 times further out than when the curve last crossed the same radial line.

Nautilus

Nautilus

Shell Nautilus

The curve of this shell is called Equiangular or Logarithmic spirals and are common in nature, though the 'growth factor' may not always be the golden ratio.

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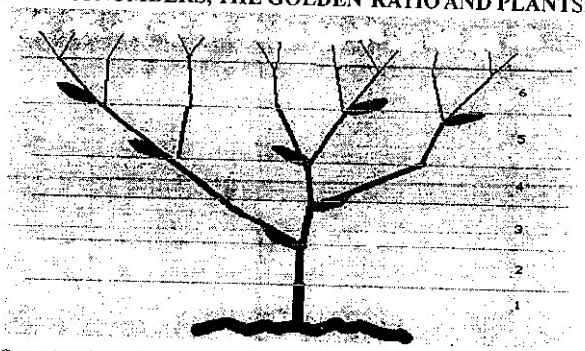
4. FIBONACCI NUMBERS, THE GOLDEN RATIO AND PLANTS:

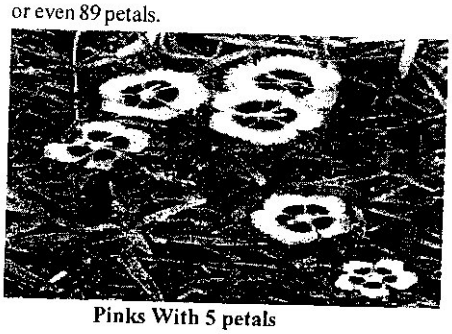


One plant in particular shows the Fibonacci numbers in the number of "growing points" that it has. Suppose that when a plant puts out a new shoot, that shoot has to grow two months before it is strong enough to support branching. If it branches every month after that at the growing point, we get the picture shown here.

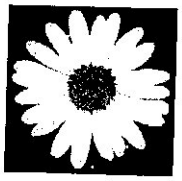
A plant that grows very much like this is the "sneezewort": Achillea ptarmica.

Petals on flowers:

On many plants, the number of petals is a Fibonacci number:
buttercups have 5 petals; lilies and iris have 3 petals; some delphiniums have 8; corn marigolds have 13 petals; some asters have 21 whereas daisies can be found with 34, 55 or even 89 petals.



Pinks With 5 petals



Daisy with 21 petal:

Pinks with 5 petals:

Daisy with 21 petals

3 petals: lily, iris .

4 petals Very few plants show 4 petals (or sepals) but some, such as the fuchsia above, do. 4 is *not* a Fibonacci number!

5 petals: buttercup, wild rose, larkspur, columbine (aquilegia), pinks (shown above)

The humble buttercup has been bred into a multi-petalled form.

8 petals: delphiniums

13 petals: ragwort, corn marigold, cineraria, some daisies

21 petals: aster, black-eyed susan, chicory

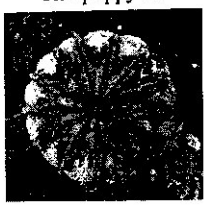
34 petals: plantain, pyrethrum

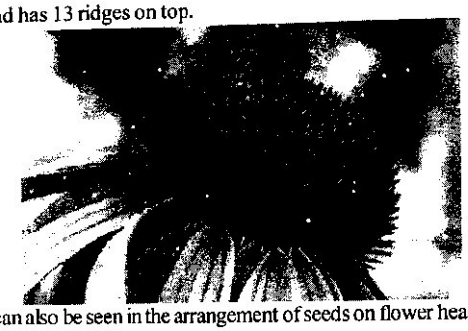
55, 89 petals: michaelmas daisies, the asteraceae family.

Some species are very precise about the number of petals they have - e.g. buttercups, but others have petals that are very near those above, with the average being a Fibonacci number.

Seed heads:

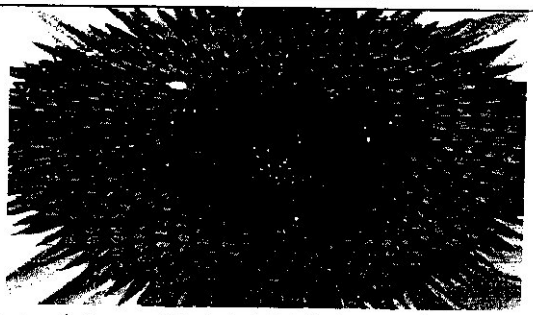
This poppy seed head has 13 ridges on top.



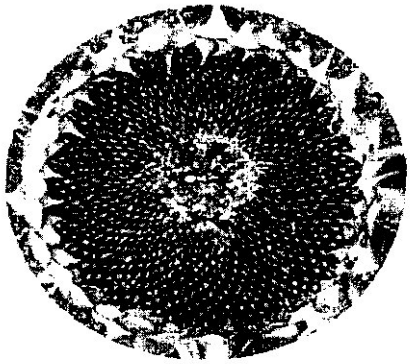


Fibonacci numbers can also be seen in the arrangement of seeds on flower heads. The picture here is a coneflower. The part of the flower in the picture is about 2 cm across. It is a member of the daisy family .

You can see that the orange "petals" seem to form spirals curving both to the left and to the right. At the edge of the picture, if you count those spiralling to the right as you



go outwards, there are 55 spirals. A little further towards the centre and you can count 34 spirals. How many spirals go the other way at these places? You will see that the pair of numbers (counting spirals in curing left and curving right) are neighbours in the Fibonacci series.



This is a larger sunflower with 89 and 55 spirals at the edge

The same happens in many seed and flower heads in nature. The reason seems to be that this arrangement forms an **optimal packing** of the seeds so that, no matter how large the seed head, they are uniformly packed at any stage, all the seeds being the same size, no crowding in the centre and not too sparse at the edges.

The spirals are patterns that the eye sees, "curvier" spirals appearing near the

centre, flatter spirals (and more of them) appearing the farther out we go.

So the number of spirals we see, in either direction, is different for larger flower heads than for small. On a large flower head, we see more spirals further out than we do near the centre. The numbers of spirals in each direction are (almost always) neighbouring Fibonacci numbers!

No matter how big the seed head gets, the seeds are always equally spaced. At all stages the Fibonacci Spirals can be seen.

5. LEAF ARRANGEMENTS

Also, many plants show the Fibonacci numbers in the arrangements of the leaves around their stems. If we look down on a plant, the leaves are often arranged so that leaves above do not hide leaves below. This means that each gets a good share of the sunlight and catches the most rain to channel down to the roots as it runs down the leaf to the stem.

Leaves per turn:

The Fibonacci numbers occur when counting both the number of times we go around the stem, going from leaf to leaf, as well as counting the leaves we meet until we encounter a leaf directly above the starting one. If we count in the other direction, we get a different number of turns for the same number of leaves. The number of turns in each direction and the number of leaves met are three consecutive Fibonacci numbers! For example, in the top plant in the picture above, we have 3 clockwise rotations before we

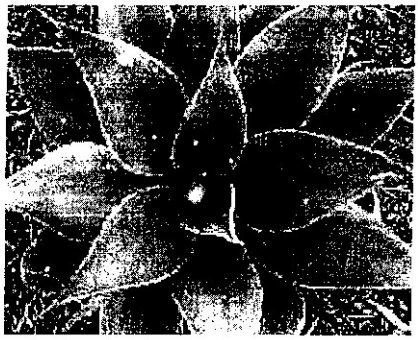
meet a leaf directly above the first, passing 5 leaves on the way. If we go anti-clockwise, we need only 2 turns. Notice that 2, 3 and 5 are consecutive Fibonacci numbers.

For the lower plant in the picture, we have 5 clockwise rotations passing 8 leaves, or just 3 rotations in the anti-clockwise direction. This time 3, 5 and 8 are consecutive numbers in the Fibonacci sequence.

We can write this as, for the top plant, 3/5 clockwise rotations per leaf (or 2/5 for the anticlockwise direction). For the second plant it is 5/8 of a turn per leaf (or 3/8).

The sunflower here when viewed from the top shows the same pattern. It is the same plant whose side view is above. Starting at the leaf marked "X", we find the next lower leaf turning clockwise. Numbering the leaves produces the patterns shown here on the right.

The leaves here are numbered in turn, each exactly 0.618 of a clockwise turn (222.5°) from the previous one.



This interesting behavior is not just found in sunflower seeds.

Leaves, branches and petals can grow in spirals, too.

Why? So that new leaves don't block the sun from older leaves, or so that the maximum amount of rain or dew gets directed down to the roots.

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You will see that the third leaf and fifth leaves are next nearest below our starting leaf but the next nearest below it is the 8th then the 13th. How many turns did it take to reach each leaf?

The pattern continues with Fibonacci numbers in each column!

Leaf arrangements of some common plants

One estimate is that 90 percent of all plants exhibit this pattern of leaves involving the Fibonacci numbers. Some common trees with their Fibonacci leaf arrangement numbers are:

1/2 elm, linden, lime, grasses
1/3 beech, hazel, grasses, blackberry
2/5 oak, cherry, apple, holly, plum, common groundsel
3/8 poplar, rose, pear, willow
5/13 pussy willow, almond

where t/n means each leaf is t/n of a turn after the last leaf or that there is there are t turns for n leaves.

Conclusion:

Nature has its own rules .But when Mathematics occurs in it , it is awesome . Most plants (but not all) shows Fibonacci numbers, Golden ratio and Fibonacci spirals in the arrangement of their branches, leaves, flowers, seeds

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१. आर.के.जुंभळे यांचे 'अशा तुडविल्या काटेरी वाटा': सशक्त स्वकथन

प्रा. डॉ. अनंत सिरसाट
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जिजामाता महाविद्यालय
बुलढाणा

आत्मचरित्र, चरित्र, आत्मकथन, स्वकथन अशा अनेक संज्ञा या साठी वापरल्या जातात. हा वाङमयप्रकार खऱ्या अर्थाने नावारुपाला आला तो इंग्रजाच्या कालखंडात. इंग्रजी साहित्याच्या अभ्यासातूनच हा वाङ्मय प्रकार विकसित झाला. मराठी विश्वकोषात आत्मचरित्राची व्याख्या दिली आहे. ती पुढील प्रमाणे - "आत्मकथा म्हणजे आत्मचरित्र होय. आपल्या स्वत:च्या जीवनासंबंधी लेखक जे काही लिहतो ते आत्मचरित्र होय." "आपल्या स्वत:च्या जीवनाचे सिंहावलोकन म्हणजे आत्मचरित्र होय" असी साधी सोपी सरळ व्याख्या आत्मचरित्र संबंधी सांगता येईल. आत्मचरित्र साधारणत: आयुष्याच्या संध्याकाळी लिहण्याचा प्रघात आहे. कारण आयुष्याच्या संध्याकाळी म्हणजे म्हातारपणी माणसाचे कर्तृत्व संपलेले असते. यापुढे आपल्या हातून कोणतेच कार्य होणे शक्य नाही याची जाणिव झाल्यानंतरच माणसे भूतकाळात रमतात. यापूढे माझ्या हातून कोणतेही कार्य होणार नाही. याची जाणिव झाल्यावरच मनुष्य: आत्मचरित्र लेखनाकडे वळतो. आतापर्यंत आयुष्यात मला जसे वांगले वाईट अनुभव आले. कोणत्या अडीअडचणींना संकटांना आपत्तींचा सामना करावा लागला. या सर्व संकटाशी सामना करून आयुष्य सफल झाले. या खडतर जीवनात संकटांशी परिस्थितीशी कशा प्रकारे सामना केला. संघर्ष केला. आणि जीवन सफल केले याचा इतिहास भावी पिढी साठी मार्गदर्शक ठरू शकतो. असे जाणवते जेव्हाच मनुष्य आत्मचरित्र लिहण्यास प्रवृत्त होतो.

आत्मचरित्र हे आयुष्याच्या संध्याकाळी लिहायचे असते या नियमाला छेद दिला तो दलित आत्मकथनांनी. दलित साहित्यिक या वाङ्मय प्रकाराला स्वकथन म्हणतात. कारण तथागतांच्या धम्मात आणि डॉ.बाबासाहेब आंबेडकरांच्या तत्वात व विचारांमध्ये आत्मा हा शब्द बसत नाही. म्हणून दलित साहित्यिक या वाङमय प्रकाराला स्वकथन म्हणतात.

स्वातंत्र्यानंतर शिक्षण हे सार्वत्रीक झाल्यामुळे ज्ञानाची गंगा ही खेडयापाडयातील,

डोंगरदयातील, उपेक्षित, दलित शोषित समाजा पर्यंत त्याच्या झोपडी पर्यंत शिक्षणाची गंगा गेली. या ज्ञानगंगेच्या प्राशणाने १९६० नंतर समाजातील सर्वच समाजस्तर जागृत झाले. ग्रामीण दलित, आदिवासी, भटक्या विमुक्त स्त्रीया या सर्वच स्तर जागृत झाले.

जेव्हा त्यांनी मराठी साहित्यात, आत्मचरित्रात आमच्या पुर्वजांनी भोगलेल्या, सोसलेल्या दु:खाचा लवलेशही त्यांना साहित्यात दिसला नाही. ग्रामीण भागातील शेतकऱ्यांच्या मुलांनी पाहिले की माझा बाप दिवस रात्र कोणताही ऋतू असो पावसाळा, हिवाळा, उन्हाळा या ऋतू तो राबराब राबतो. ऊर फुटेस्तव राबतो. त्याला एकही दिवस सुटी नसते. दिवाळी, दसरा, ना रविवार एकही सुटी तो घेत नाही. तो राबतो व सगळयांना खावू घालतो. हा शेतकरी जगाचा पोशिंदा आहे. परंतु त्याच्या दु:खाबद्दल एक चकार शब्दही प्रस्तापीत साहित्यात त्याला दिसला नाही. त्याच प्रमाणे आदिवासी समाजातील तरुण शिकले त्यांनाही आपल्या समाजातील दु:खाची नोंद कोणत्याही साहित्य प्रकारात मुखर केल्याचे दिसले नाही. दलीत समाजाला, भटक्या विमुक्तांनाही आपल्या पुर्वजांच्या दु:खाबद्दल कोणीही लिहले नाही. असे दिसताच सर्व समाजस्तर साहित्यातून मुखर व्हायला लागले.

या सर्वच समाज स्तरातील समाजाला आत्मभान आले म्हणून त्यांनी आपल्या पुर्वजांनी भोगलेल्या यातनांना समाजाच्या वेशीवर मांडण्याचे ठरवले. याला साहित्यात स्थान दिले. या त्यांच्या गरजेतूनच वास्तववादी साहित्य मराठी साहित्यात अस्तित्वात आले.

डॉ.बाबासाहेब आंबेडकरांच्या धर्मपरिवर्तनाच्या विश्वातील सगळयात मोठया धम्म कांतीपासून समाजात नवचैतन निर्माण झाले. बाबासाहेबांनी दलित समाजाचे आत्मभान जागृत केले. यामुळे दलित समाजाची अस्मिता जागृत झाली. जेव्हा या समाजाने पहिले की आमच्या पुर्वजांना पशुवत जिवन जगण्याला भाग पाडले. त्यांना अस्पृश्य म्हणून हिणवल्या गेले. त्यांना गाव कुसाबाहेर राहण्यास भाग पाडले त्याच्या दु:खाबद्दल कोणी सखोलपणे काहीच लिहले नाही. म्हणून त्यांनी वयाची वाट न पाहता आपल्या समाजाच्या दु:खाचा साहित्यातून वाट मोकळीकरून दिली. त्यांनी अगदी पंचवीस, पस्तीसित त्यांनी स्वकथन लिहीले.

दलित लेखकांच्या स्वकथनांनी मराठी साहित्यातील आत्मचरित्राचे दालन सुशोभित झाले. त्यात त्यांनी फार मौलिक भरच घातली असे माझे स्पष्ट मत आहे.

१९६० नंतर अनेक जातीवर्णीय लेखक आपल्या गावचावडीतील वास्तव जीवन मांडू लागले. त्यातूनच दलित साहित्य प्रवाह चहूअंगाने वेदना, विद्रोह, नकार इ. मुल्यांना

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स्वीकारत जुन्या सांस्कृतिक मूल्यांच्या विरोधात प्रभावीपणे बोलू लागला. दलितांची वाङ्मयीन निर्मिती ही पारंपारिक अभिव्यक्ती पेक्षा वेगळी आहे. दलित साहित्याचा प्रवाह या स्वकथनांमुळे व्यापक झाला.

दलित लेखकाने स्वकथन लिहले तर ते फक्त त्याचे जीवन चरित्र नसते तर त्यात समुहमनाची भावना अधोरेखित होत असते. दलित, आदिवासी व भटक्या विमुक्त या सर्वच समुहाची वेदना आविस्कृत होते. या अधांर युगात ज्या समाजाचे शोषन झाले त्या बळी ठरलेल्या समुहाचे चित्रण प्रतिनिधिक रुपाने येते.

याच पार्श्वभूमीवर आपल्याला १५ ऑगस्ट १९१८ ला प्रकाशित झालेल्या "अशा तुडविल्या काटेरी वाटा" रामराव कोंडुजी जुमळे यांच्या स्वकथनाची चिकित्सा करावयाची आहे. चौधरा एक छोटस खेड. या गावात लेखक कष्टकरी दलित कुटुंबात जन्माले आले. वडील कोडुंबा आई अलुकाबाई यांच्या पोटी तीन मुल जन्माला आले. मोठा शामराव दुसरा रामराव तिसरा अज्याप ही ती मुलं रामराव कोंडुबा जुमळे या आत्मकथनाचे नायक. रामराव यांच्या वाटयाला आलेले जीवन त्यांना करावा लागनारा संघर्ष, अडीअडचणी, त्यांच्यावर आलेले संकटे. या विपरित परिस्थितीवर मातकरून मोठा संघर्ष करून संकटांशी दोन हातकरून त्यांनी या संकटावर कशी मात केली. या संघर्षाची कहाणी येणाऱ्या दलित समाजाच्या तरुणांना मार्गदर्शक ठरेल. या हेतूनेच ते स्वकथन लिहण्यास प्रवृत्त झाले.

लेखकाचा आणखी एक हेतू आहे स्वकथन लिहण्यामागे ते म्हणतात "आजच्या पिढीला ज्या सुखसोयी सुविधा उपलब्ध झाल्यात. त्या काही त्यांना एकाएकी आपोआप मिळाल्या नाहीत. त्यामागे मागील पीढीचा त्याग, कष्ट, निर्धार व डॉ.बाबासाहेब आंबेडकरांची शिकवण आणि प्रेरणा याचे मोठे पाठबळ आहे. ही बाब आजच्या या येणाऱ्या पिढीला कळणे आवश्यक आहे. तेव्हाच आमचे मोल यांना कळेल, असे वाटते. हा उद्देश मी लिखाणा मागे ठेवला आहे." (मनोगत पान ८)

या विकासाच्या प्रगतीच्या मागे फक्त आणि फक्त डॉ.बाबासाहेब आंबेडकर नावाच्या महापुरुषाचा त्याग त्यांनी घेतलेले अविश्रात श्रम. समाजाच्या उत्कर्षा साठी घेलेला ध्यास. त्यांनी केलेले समर्पण ध्याच गोष्टी कारणीभूत आहेत.याची जाणिव आजच्या तरुणांना असावी हाच उद्देश लेखकाचा आहे.

लेखकाने प्रतिकूल परिस्थित शिक्षण बी.कॉम पर्यंतचे शिक्षण घेऊन १९७१ साली महाराष्ट्र राज्य विद्युत मंडळात लिपीक पदाची नोकरी लागेपर्यंतची जीवनकथा ३५ प्रकरणातून

विभागून मांडली आहे.

आर.के.जुमळे यांचे स्वकथन हे वास्तवादी स्वकथन आहे. त्याच्यातील प्रत्येक प्रसंग, प्रत्येक घटना जशी घडली तशीच त्यांनी मांडली आहे. नाव कोठेच कपोलकल्पित भाग नाही. जसे जगलो तसाच मी साहित्यात आहे. या नारायण सुर्वेच्या साहित्यातील प्रामाणिकपणा यांच्या स्वकथनात दिसतो.

महाराष्ट्रातील हजारो खेडयापैकी यवतमाळ जिल्हयातील चौधरा हे छोटस गाव. प्रत्येक गावाप्रमाणेच दिसणारे जात वास्तव ही ग्राम जीवनातील जाती द्वैषातून निर्माण होणारे कलह, वीष निर्माण करणारी, गलीच्छ व्यवस्था चौधरा या गावात दोन जाती एक बौद्ध समाज, दुसरी बंजारा समाज. तसे खरे तर दोन्हीही जाती हया अस्पृश्य, भटक्या विमुक्त जातीतील जाती. परंतु यांच्यात फार मतभेद , बंजारा समाजाची एक आगळी वेगळी संस्कृती आहे. त्यांची भाषा पेहराव, सण, पुजाअर्चा करण्याची पद्धती वेगळी आहे. बंजारा हे बौद्ध समाजाचा लाग, बाट करतात. त्यांना अस्पृश्य म्हणून त्यांना हिणवतात व तसेच वागवतात.

या समाजाला हेही समजत नाही की या वर्ण व्यवस्थेमुळे, जातीवादामूळेच आपल्या समाजाचे शोषण झाले आहे. तसे बंजारा समाजचे शोषण झाले तसेच दलित समाजाचे ही झाले आहे. एवढा साधा विचारही लोक करत नाही. हे आहे जात वास्तव.

स्वातंत्र्यानंतरही जाती व्यवस्था का टिकली याचे कारण काय असेलत तर या व्यवस्थेन एक जात दुसऱ्या जातीपेक्षा श्रेष्ठ आहे. अशी व्यवस्था यात आहे. म्हणून वरिल जाती आपल्यापेक्षा श्रेष्ठ आहे. परंतु आपल्यापेक्षाही कोणी खालच्या पायरीवर आहे. आपली जात काही जातीपेक्षा का असेना श्रेष्ठ आहे. वरच्या दर्जाची आहे. हीच ती भावना जात व्यवस्था टिकण्यास कारणीभूत आहे. मी जातीची फार सोपी व्याख्या करतो. `जी जात नाही ती जात' हेच जात वास्तव आहे. यानेच लेखक फार अस्वस्थ होतो.

या दोन समाजात भेद आहेत परंतु बंजारा समाजातही एकी नाही. एकता नाही.बंजारा जातीतही किती उपजाती पोटजाती आहेत. बंजारा जातीत. राठोड, चव्हाण,पवार, आडे, जाधव, नाईक या आडनावाचे लोक चौथारात होते. राठोड हे कोल्हा, भूकीया, रातळा, खाटरोत, चव्हाण हे पालत्या तर पवार हे झरपाला पोटजातीत येत. या पोटजातीतील लग्न हे त्याच पोट जातीतील तरुण, तरुणींशी होत. इतर पोटजातीत होत नव्हते.

त्यांच प्रमाणे बौद्ध म्हणजे पुर्वाश्रमिचे महार या जातीतही लाडवाण बाबणे आणि

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बारके या पोटजातीत विभागलेले आहे. लाडवानात प्रादेशिक स्तरावर, माहुरे, झाडपे, हिंगण घाटे असे प्रकार होते. लोकांचे आपसात सारे व्यवहार होत. पण जातरिवाजाप्रमाणे सोयरिकीमात्र होत नव्हत्या. लग्न फक्त पोटजातीच्या अंतर्गतच करावे असे कडक बंदध होते. नाहीतर त्यांच्या घराला जातीबाहेर टाकले जात होते.

इतर पोटजातीशी त्यांचे रोटी व्यवहार होते परंतु बेटी व्यवहार होत नव्हता. या जात वास्तवामुळे लेखक अस्वस्थ आहे. या जात वास्तवाचे चटके लेखकाला बसलेले आहेतच.

ग्रामीण भागाचे दुसरे वास्तव म्हणजे देवी-देवतांच्या पुजेच्या नावाने पसरेली अंधश्रद्धा. गावातील मातामाय, कोटेश्वर महादेव,कोतवालाच्या घरी बसलेली `ईनाई` - ``मान घे मानाई । महारा घरची ईनाई ॥ - दस-याला कापल्या जाणारा हल्या, प्लेग, पटकी कोणतीही साथ आली की गाव गाव देवीला देण्यात येणारा बळी, कोणत्याही आजारासाठी उपाय करणारा `भगत` अश्या अनेक देवदेवतांच्या नावावरुन पसरणारी अंधश्रद्धा यामुळे ग्रामीण जनजीवन आणखी चिखलात फसत चालला आहे. लेखक याही गोष्टींमूळे अस्वस्थ आहे. यावर एकच उपाय लेखकाला माहिती आहे आणि तो म्हणजे शिक्षण. यावर एकच औषध ते म्हणजे `शिका, संघटित व्हा आणि संघर्षकरा`

खेडयातील लोकांच्या अधोगतीला मागासलेपणाला आणखी काही गोष्टी कारणीभूत आहेत. ते म्हणजे सर्वच प्रकारची व्यसनाधिनता उदा. दारु. वरली मटका, पत्ते खेळणे, बीडी, तंबाखू यामूळे त्यांचे वैयक्तिक जीवन तर नष्ट होतेच परंतु त्याच सोबत त्यांचे कौटुंबिक जीवनही संपुष्टात येते. लेखकाला योग्य वेळी योग्य मार्गदर्शक भेटला म्हणून ते या सर्वच व्यसनापासून वाचले. या विषयी लेखकाने प्रामाणिकपणे आपल्या चुकांची कबुली दिली आहे. प्रामाणिकपणा, प्रांजळपणाने नटलेले हे स्वकथन आहे. यात शंकाच नाही.

वास्तविक लेखकाच्या वाटयाला आलेले जीवन त्यांना शिक्षणासाठी करावा लागणारा संघर्ष, कौटुंबिक पीळ ताणतणाव हे काही त्यांच्याच वाटयाला आले होते का तर नाही.

लेखकच मनोगतात म्हणतात - ``ज्या काळात ज्या परिस्थितीत मी जगत होतो. हे त्या समुहाचं सार्वत्रिक जीवन होतं. सर्वजण असे जगतात. मग माझ्या जगण्यात असं काय आगळंवेगळ आहे. ते मी लोकांना सांगू ... ?

असे प्रामाणिकपणे व्यक्त करत असतील तरीही त्यांच्या वाटयाला आलेल.

जीवन, करावा लागणारा संघर्ष झालेले अपमान हे भीषणच होते यात शंकाच नाही. लेखक रामराव जुमळे प्रामाणिक पणे सांगत असले तरीही माझ्या दृष्टिने हे स्वकथन दलित स्वकथनात मैलाचा दगड ठरावे असे स्वकथन आहे. असे कोणते नाविण्य मैलाचा दगड ठरावे असे कोणते वैशिष्ट या स्वकथनात आहे.

या स्वकथनातील नाविण्य, वैशिष्टये हे आहे की -

डॉ.बाबासाहेब आंबेडकरांच्या धम्मचक्रप्रर्वर्तनाचा ६२ ते ६३ वर्षे होत आहे. डॉ.बाबासाहेबांच्या विचारावर आधारित चळवळीची आजचे काय वास्तव आहे. याचा शोध रामराव जुमळे घेतात. हा शोध त्यांच्यातील लेखकाचा नाही. तर तो त्यांच्यातील आंबेडकरी कार्यकर्त्याचा, नेत्याचा, विचारवंताचा शोध आहे. नोकरिच्या सुरवातीच्या काळात कम्युनिस्ट कामगार संघटना`, मागासवर्गीय विद्युत कर्मचारी संघटना; बोद्धकर्मचारी समाज सुधारक मंडळ, काशीरामजी यांच्या नेतृत्वातील `बामसेफ' व `पेबॅकटू सोसायटी' या सर्व संघटनात्मक संस्थामध्ये कार्यकर्ता म्हणून, पदाधिकारी म्हणून तण,मन,धनाने ते या सर्वच चळवळींशी जुळले होते.

लेखक जेव्हा डॉ.बाबासाहेबांनंतर दलित चळवळीने समाजात केलेली वैचारिक क्रांती, झालेले सामाजिक परिवर्तन समाजामध्ये झालेली जाणिव जागृती याने अवघा ग्रामीण, दलीत, आदिवासी,स्त्रीया, भटक्या विमुक्तांच्या जीवनात झालेले बदल. त्या सर्वांनाच आलेले आत्मभान हा सुवर्ण काळ लेखकाने अनुभवला आहे. १९७०-८० पर्यंतचा काळ हा चळवळीचा सुवर्ण काळ होता.

साठ-बासस्ट वर्षानंतरच्या चळीवळीच्या स्वरुपाकडे अवस्थेकडे जेव्हा त्यांच्यातील कार्यकर्ता पाहतो जेव्हा त्यांचे मन, अंत:करन व्यथित होते.

डॉ.बाबासाहेब आंबेडकरांची चळवळ ही दलितांच्या सर्वांगीण उत्कर्षाची चळवळ खेळयापाडयात पोहोचली. त्यातून अनेक कार्यकर्ते उभे राहिले, त्यांनी गावाच्या नेतृत्वाचा भार उचलला याच चळवळीतून रामराव जुंमळे यांचे मोठेभाऊ शामराव जुंमळे सारखा निष्ठावान कार्यकर्ता उभा राहिला. १५ वर्षे शामराव चौधरा, गावचा सरपंच होता. गावातील कोणाचेही कोणतेही काम असो मग तहसिलचे, जिल्हापरिषदेचे, पंचायत समितीचे, कोर्टाचे असो, पोलिस स्टेशनचे, शिक्षणाचे असो ते काम शामराव जुंमळे करीत होते. हे काम करतांना अनेक अधिकाऱ्यांना पैसे देवून लाच देऊन काही वेळा दारु व मटणाची पार्टी देवून काम करित होता. या कामाच्या मोबदल्यात शामरावांना काय मिळाले तर विषारी दारुचे

व्यसन लागले.

हा फक्त शामराव जुंमळे या एका कार्यकर्त्यांचा प्रश्न लेखक मांडत नाही तर तमाम महाराष्ट्रातील रिपब्लिकन पार्टीच्या नेत्यांचा, कार्यकर्तांचा प्रश्न समाजासमोर गांभीर्याने मांडतात ते म्हणतात.

"रिपब्लिकन पार्टीच्या पुढाऱ्यांनी बाबासाहेबांनी जीवनभर बाळगलेली व भगवान बुद्धांनी शिकविलेली नैतिकता न रुजविता त्यांनी कार्यकर्त्यांना व्यसनाधीन बनविले होते. असा कटू अनुभव मी घेतला. दादाला पण त्यांच्या दूषित संसर्गामुळे दारूच व्यसन जडलं होते."

दुर्गणी माणसांच्या संगतीत माणसाला व्यसणे लागतात. या चळवळीतील लोकांनी सत्ताधाऱ्यांच्या हाताखालचे बाहुले होण्यात धन्यता मानली. त्यांच्या व्यसनांसाठी, सत्तेसाठी, पैशासाठी या गाव पुढाऱ्यांनी गावोगावी दारु-स्पिरीटची दुकान थाटली होती. स्पिरीट अत्यंत ज्वलनशील प्रवाही पदार्थ ! याची दारु विकण्याचा धंदा सुरू केला. लेखकाच्या मते समाजाच स्वास्थ बिघडविण्यासाठी हेच महान पुढारी कारणीभूत आहेत. म्हणून लेखक या पुढाऱ्यांनाच दोषी ठरवतात. माझ्या दादाला यांनी दारूच्या व्यसनात बुडवल हे भीषण सत्य ही लपवू शकत नाही. असे कितीतरी गावोगावचे शामराव यांनी नासवले असतील. मूळात हे दलित चळवळीत वक्ते, कलावंत होते. चांगले वादक, गायक, कवी असूनही या कार्यकर्त्यांची भीषण शोकांतिका झाली. याचे लेखकाला जास्त शल्य आहे.

कुठे गेली तथागत भगवान बुद्धांचे विचार कुठे गेली बाबासाहेबांची शिकवण. लेखक म्हणतात मी विचार करायचो - कुठे गेली ती बाबासाहेबांची प्रेरणा पेरणारे व लोकांमध्ये स्फुलिंग पेटवणारी भजन मंडळे ?.....

कुठे गेला तो पंचशील झेंडयाजवळ त्रिशरण, पंचशील बंदनेसाठी एकोप्याने जमणारा, धम्मरस ग्रहण करणारा समुह प्रत्येकाच्या जीवनाला शिस्त लावणारे, समाजात आदर्श निर्माण करणारे. बाबासाहेबांनी स्थापन केलेले समता सैनिक दल ? बाबासाहेबांनी दाखविलेल्या उच्चनैतिक मुल्यव्यवस्थेच्या अधिष्ठानावर वाटचाल करणारे पुढारी का निपजले नाहीत ? त्यांनी बाबासाहेबांच्या बाबीस प्रतिज्ञा का शिकविल्या नाहीत ? भारत बौद्धमय करणे दूरच, उलट वैयक्तिक स्वार्थापायी समाज रसातळाला जात आहे. याची कुणालाच चिंता राहिली नाही. अशा गहण प्रश्नांनी मला सतावून सोडले होते.

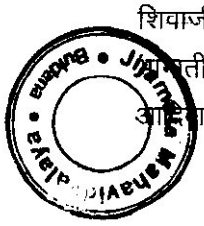
अंगात भिनलेल्या दारुच्या नशेत हात जोडून पंचशील म्हणताना मी लोकांना

पाहिले. `मी नशा आणणाऱ्या कोणत्याही नशील्या पदार्थाचे सेवन करणार नाही. असा अर्थ त्यांना कुठे माहिती होतो ? दारुचा घोट घेण्यापुर्वी, `घ्या, जयभीम....! असे मोठयाने म्हणणारे लोक मी पाहिले. त्या बाबासाहेबांनी आपल्या जीवनात इंग्लंड, अमेरिका सारख्यादेशात शिकायला राहून कधी दारुला हात लावला नाही ; तेव्हा `जयभीम` म्हणताना यांची जीभ का आटूरत नाही. असे अनेक प्रश्न माझ्या मनात थैमान घालीत असत.

समाजाचा विश्वासघात केला तो या पुढाऱ्यांनी आणि काही शिकलेल्या नोकरदार वर्गाने तर समाजाशी असलेली नाळच तोडून टाकली. मोल मजूरी करणारा खेडयातील भावाकडे त्याच्या मुलांकाडे दुर्लक्ष केले. गावातील भाऊ शहरात राहणाऱ्या भावाला म्हणतो, " तूकाय, मोठा झालास ? आमची तुला काय चिंता ? अस जेव्हा रक्ताच नात तुटायला लागत, तंथे समाजाचं नातं तर दूरच राहिल. याला जबाबदार कोण ? हा पांढरपेशा शिकलेला व राजकारण करणारा पुढारी असे दोन्हीही याला जबाबदार नाही का ?

१९७५ पर्यंत बाबासाहेबांच्या विचारावर, तत्व ज्ञानावर आधारलेली दलित चळवळ योग्य दिशेन होती. नंतर मात्र चळवळीच्या पुढाऱ्यांची सत्तालालसा जागृत झाली. आणि त्यांनी वाटणी केली. त्यामूळे दलित सामाजही चार दिशांमध्ये विभागला गेला. त्या कार्यकत्यांची आज काय अवस्था आहे. याचा शोध हे स्वकथन घेते. स्वत:च्याच समाजातील चळवळरचे कठोरपणे, निदर्यपणे केलेले हे आत्मपरिक्षण आहे. स्वत:च्या समाजालाच आरसा दाखवण्याच हा प्रयत्न आहे. या स्वकथनाचे हे बलस्थान आहे. इतक्या कठोरपणे केलेले हे आत्मपरिक्षण फार कलात्मक पद्धतीने लेखकाने मांडले आहे. साधी सोपी, भाषाशैली हेही या स्वकथनाची जमेची बाजू आहे.

अशा प्रकारे स्वत:च्याच काळजाचे स्वता:च्याच हाताने केलली ही चिरफाड असते. ही मोठी सर्जिरी आहे. हे या स्वकथनाचे वैशिष्टय आहे. आजपर्यंतच्या स्वकथनात इतक्या कठोरपणे सडेतोडपणे, स्पष्टपणे कोणत्याही लेखकाने मांडल्याचे वाचनात नाही. यामूळे `अशा तुडविल्या काटेरी वाटा` हे स्वकथन दलित स्वकथनातील मैलाचा दगड ठरावे असेच आहे.आर.के.जुमळे यांचे हे स्वकथन नवीन वाटा निर्माण करणारे स्वकथन आहे असेच वाटते. ही फक्त दलित चळवळीतील कार्यकर्त्यांची शोकांतिका नाही. छत्रपती शिवाजी महाराजांच्या नावाने उभी राहिलेली सामाजिक व राजकीय चळवळीत ग्रामीण भागातील शिवसेनेचा कार्यकर्ता असो. महात्मा ज्योतीबा फुलेंची सामाजिक चळवळ असो. आदिवासींची चळवळ असो. त्या प्रत्येक चळवळींच्या कार्यकर्त्यांची ही शोकांतिकां प्रतिनिधित्व



करते. प्रत्येक चळवळीतील नेत्यांना व कार्यकर्त्यांना हे स्वकथन आत्मचिंतन करायला भाग पाडते.

चळवळीतील दुःख सांगणे हा लेखकाचा हेतू नाही हे सुधारावे हिच या लिखानामागची अपेक्षा आहे. ही अपेक्षा अधोरेखित करून प्रत्येक दलित कार्यकर्त्याने व समाजाने स्वतःला सुधारून चळवळीला योग्य दिशेला न्यावे याच साठी हा लेख प्रपंच.

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Bianchi Type-V Minimally Interacting Holographic Dark Energy Cosmological Model with Sepcial from of Deceleration Parameter in f(R,T) Gravity

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4 Research Paper - Mathematics

ABSTRACT

Bianchi type-V cosmological model is studied in the framework of gravity proposed by Harko et al. (Phys. Rev. D. 84:024020, 2011). The source for energy momentum tensor is minimally interacting two fluids viz. matter and holographic dark energy. The field equations have been solved by applying a special form of deceleration parameter proposed by Singa and Debnath (IJTP 48:351, 2009). The physical aspects of the models are also discussed.

Keywords: $f(R,T)$ gravity, Holographic dark energy, Special form of deceleration parameter.

Introduction:

For providing natural gravitational alternative for dark energy, there have been several modifications in general theory of relativityduring the last decade. Among the various modifications, theory of gravity is treated most suitable due to cosmologically important models.$f(R)$ It has been suggested that cosmic acceleration can be achieved by replacing the Einstein-Hilbert action of general relativity with a general function Ricci

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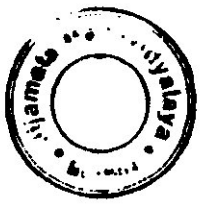
scalar. $f(R)$ .Harko et al. [1] proposed another extension of standard general relativity. $f(R,T)$ modified theories of gravity, where in the gravitational Lagrangian is given by an arbitrary function of the Ricci scalarRand of the trace of the stress energy tensorT . It is to be noted that the dependence from T may be induced by exotic imperfect fluids or quantum effects. They have derived the field equations from a Hilbert-Einstein type variational principal. In addition they also obtained the covariant divergence of the stress-energy tensor. The gravity model depends on a source term representing the variation of the matter stress energy tensor with respect to the metric. Naidu et al. [2] studiedBianchi type-V cosmological model in $f(R,T$ gravity when the source for energy momentum tensor is a bulk viscous fluid containing one dimensional cosmic strings. Ahmed et al. [3] constructed a new class of cosmological models in gravity by considering time dependent deceleration parameter for a specific choice of . $f(R,T) = f_1(R) + f_2(T$ Recently, Zaregonbadiet al. [4] have studied dark matter from $f(R,T$)gravity.

A new alternative to the solution of dark energy problem may be found in the 'Holographic Problem. Holographic dark energy models have emerges from the holographic principle [5] which states that the number of degrees of freedom directly related to entropy of the system scales with the enclosing area of the system. By applying this principle to cosmology, the upper bound of the entropy contained in the universe can be obtained. Holographic dark energy models have been tested and constrained by various astronomical observations [6-11]. Recently, Ghateet. al. [12] has studied Kantowski-Sachs Minimally Interacting Holographic Dark Energy Cosmological Model in Saez-Ballester Theory of Gravitation.

Berman [13] proposed a special law of variation for Hubble's parameter to obtain the cosmological solutions called the models with Constant Deceleration Parameter (CDP) by assuming . $q = -\frac{R\ddot{R}}{\dot{R}^2} = \text{constant}$ Many cosmologist [14-16] investigated that, for a universe which is decelerating in the past and accelerating at present time, DP parameter must show signature flipping. In 2009, Singha and Debnath[17] have investigated the quintessence model with a minimally coupled scalar field by taking a special form of deceleration parameter in such a way that the



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model behaves early decelerating and late time accelerating for barotropic fluid and chaplygin gas dominated models. The special form of DP is defined as $q = -1 + \frac{k}{1+R^k}$ where k is a constant and R is average scale factor. Ghatect al.[18] have investigated Bianchi type-ix minimally interacting holographic dark energy cosmological model with special form of deceleration parameter in f(R, T) gravity.

In this paper, Bianchi type-V space time has considered when universe filled with minimally interacting with holographic dark energy in $f(R,T)$ theory of gravity with special form of deceleration parameter. This work is organized as follows: In Section 2, the model and field equations have been presented. The field equations have been solved in Section 3 by applying special form of deceleration parameter. The physical aspects of the model have been discussed in Section 4. In the last Section 5 concluding remarks have been expressed.

Metric and Field Equations:

Bianchi type-V metric has considered in the form of

$$ds^2 = -dt^2 + a_1^2 dx^2 + e^{2\omega x} a_2^2 dy^2 + a_3^2 dz^2 \quad (1)$$

where metric potentials a_1, a_2 and a_3 are functions of cosmic time t and ω is a positive constant.

The energy momentum tensor of matter is

$$^{(m)}T_i^j = [\rho_m, 0, 0, 0]. \quad (2)$$

where ρ_m is the matter energy density of the universe.

The energy momentum tensor of the anisotropic holographic dark energy is

$$^{(HDE)}T_i^j = [\rho_\lambda, -P_\lambda, -P_\lambda, -P_\lambda]. \quad (3)$$

Using dark energy equation of state

$$P_\lambda = \omega\rho_\lambda. \quad (4)$$

where ω is deviation free EoS parameter of the fluid. The equation (3) becomes

$$^{(HDE)}T_i^j = [1, -\omega, -\omega, -\omega]\rho_\lambda. \quad (5)$$

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where ρ_Λ is the energy density of the holographic dark energy while p_Λ is the isotropic pressure.

The field equations in $f(R,T)$ theory of gravity for the function $f(R,T) = R + f(T)$ when the source for the fluid is anisotropic holographic dark energy is

$$R_{ij} - \frac{1}{2}Rg_{ij} = 8\pi T_{ij} + 2f'(T)T_{ij} + [2pf'(T) + f(T)]g_{ij}, \quad (6)$$

and

$$T_{ij} = {}^{(m)}T_{ij} + {}^{(HDE)}T_{ij}, \quad (7)$$

where, the prime denotes derivative with respect to the argument. Now, we choose the function $f(T)$ of the trace of the stress-energy tensor of the matter so that

$$f(T) = \mu T, \quad (8)$$

where μ is constant.

The energy conservation equation is

$$T^{ij}_{;j} = {}^{(m)}T^{ij}_{;j} + {}^{(HDE)}T^{ij}_{;j} = 0. \quad (9)$$

In the co-moving coordinate system the field equations (6) for the metric (1) and with the help of (2) to (5) and (7), (8) can be written as

$$\frac{\dot{a}_1\dot{a}_2}{a_1a_2} + \frac{\dot{a}_2\dot{a}_3}{a_2a_3} + \frac{\dot{a}_1\dot{a}_3}{a_1a_3} - \frac{3\alpha^2}{a_1^2} = \rho_m(8\pi + 5\mu) + \rho_\Lambda(8\pi + 3\mu - \mu\omega - 2\mu\delta), \quad (10)$$

$$\frac{\ddot{a}_2}{a_2} + \frac{\ddot{a}_3}{a_3} + \frac{\dot{a}_2\dot{a}_3}{a_2a_3} - \frac{\alpha^2}{a_1^2} = 3\mu\rho_m + (-8\pi\omega - 3\mu\omega + \mu - 2\mu\delta)\rho_\Lambda, \quad (11)$$

$$\frac{\ddot{a}_1}{a_1} + \frac{\ddot{a}_3}{a_3} + \frac{\dot{a}_1\dot{a}_3}{a_1a_3} - \frac{\alpha^2}{a_1^2} = 3\mu\rho_m + (-8\pi\omega - 3\mu\omega + \mu - 4\mu\delta - 8\pi\delta)\rho_\Lambda, \quad (12)$$

$$\frac{\ddot{a}_1}{a_1}+\frac{\ddot{a}_2}{a_2}+\frac{\dot{a}_1\dot{a}_2}{a_1a_2}-\frac{a^2}{a_1^2}=3\mu\omega_m+(8\pi\omega-3\mu\omega+\mu-(\mu\delta-8\pi\delta)\rho_\Lambda. \quad (13)$$

$$2\frac{\dot{a}_1}{a_1}-\frac{\dot{a}_2}{a_2}-\frac{\dot{a}_3}{a_3}=0, \quad (14)$$

where overhead dot (·) denotes differentiation with respect to time t.

On Integration of equation (14)

$$a_1^2=la_2a_3, \quad (15)$$

where l is a constant of integration.

Without any loss of generality, choose $l=1$ so that equation (15) becomes

$$a_1^2=a_2a_3 \quad (16)$$

The average scale factor R for Bianchi type-V defined as

$$R=(a_1a_2a_3)^{\frac{1}{3}} \quad (17)$$

The generalized mean Hubble parameter defined as

$$H=\frac{1}{3}\left[H_1+H_2+H_3\right]. \quad (18)$$

where $H_1=\frac{\dot{a}_1}{a_1}$, $H_2=\frac{\dot{a}_2}{a_2}$ and $H_3=\frac{\dot{a}_3}{a_3}$ are directional Hubble's factor in the direction x, y and z respectively.

From equation (17)-(18), we obtain

$$H=\frac{\dot{a}}{a}=\frac{1}{3}\left(\frac{\dot{a}_1}{a_1}+\frac{\dot{a}_2}{a_2}+\frac{\dot{a}_3}{a_3}\right) \quad (19)$$

The holographic dark energy density is given by

$$\rho_\Lambda=3(\alpha H^2+\beta H) \quad (20)$$

i.e. $\rho_\Lambda = 3(\alpha H^2 + \beta H)$ with $M_p^{-2} = 8\pi G = 1$ (Granda&Oliveros, [19]).

From equation (9) and (19), the continuity equation for matter and dark energy as

$$\dot{\rho}_m + \dot{\rho}_\Lambda + 3H(\rho_m + \rho_\Lambda + p_\Lambda) = 0$$

$$\text{i.e.} \quad \dot{\rho}_m + \dot{\rho}_\Lambda + \left(\frac{a_1}{a_1} + \frac{a_2}{a_2} + \frac{a_3}{a_3}\right)(\rho_m + \rho_\Lambda + p_\Lambda) = 0. \qquad (21)$$

Here we considered that the matter and holographic dark energy components interact minimally. Hence both the components conserve separately (Saikat [20], Kiran et al. [21]). The energy conservation equation ${}^{(m)}T^{\mu}_{;\mu} = 0$ of the matter leads to

$$\dot{\rho}_m + 3H\rho_m = 0 \qquad \text{i.e.} \quad \dot{\rho}_m + \left(\frac{a_1}{a_1} + \frac{a_2}{a_2} + \frac{a_3}{a_3}\right)\rho_m = 0. \qquad (22)$$

whereas the energy conservation equation ${}^{(\Lambda BH)}T^{\mu}_{;\mu} = 0$ for the holographic dark energy components yields

$$\dot{\rho}_\Lambda + 3H(1+\omega)\rho_\Lambda = 0 \qquad \text{i.e.} \quad \dot{\rho}_\Lambda + \left(\frac{a_1}{a_1} + \frac{a_2}{a_2} + \frac{a_3}{a_3}\right)(1+\omega)\rho_\Lambda = 0. \qquad (23)$$

Using equations (4) and (20) in equation (23), it is found that

$$\omega = -1 - \frac{2\alpha\dot{H} + \beta\dot{H}}{3H(\alpha H^2 + \beta H)}. \qquad (24)$$

Solutions of the Field Equations:

The field equations (10)–(14) is a system of five independent equations in six unknowns $a_1, a_2, a_3, \rho_m, \rho_\Lambda$ and ω. Hence to find a deterministic solution we use following plausible physical conditions.

(i) Firstly, we assume that the scalar expansion (θ) is proportional to the shear scalar (σ^2) so that we take (Collins et al., [22]).

This condition leads to

$$a_2 = a_3^n. \qquad (n \neq 1) \qquad (25)$$

where n is a positive constant which takes the care of the anisotropy of the space-time.

(ii) In order to solve this system completely, we use a special form of deceleration parameter.

$$q = -\frac{R\ddot{R}}{\dot{R}^2} = -1 + \frac{k}{1+R^3}, \quad (26)$$

where R is mean scale factor of the universe and k is positive constant.

This form has been proposed by Singa and Debnath [17] for Friedman-Robertson-Walker metric.

Integrating equations (26), we obtained Hubble parameter as

$$H = \frac{\dot{R}}{R} = \alpha_1(1 + R^{-3}), \quad (27)$$

where α_1 is an arbitrary constant of integration.

Again integrating equation (27), we get

$$R = (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{1}{3}}, \quad (28)$$

where α_2 is an arbitrary constant of integration.

With the help of equations (16) - (17), (25) and (28), solving the field equations (10)-(14), the scale factors α_1, α_2 and α_3 are obtained as

$$\alpha_1 = (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{1}{3}}, \quad (29)$$

$$\alpha_2 = (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{2n}{3(n+1)}}, \quad (30)$$

$$\alpha_3 = (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{2}{3(n+1)}}. \quad (31)$$

Using equations (29)-(31) and through a proper choice of coordinates and constants, the Bianchi type-V cosmological model in $f(R,T)$ theory of gravitation can be written as

$$ds^2 = -dt^2 + (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{2}{3}}dx^2 + e^{2mx}\left[(\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{4n}{3(n+1)}}dy^2 + (\alpha_2 e^{3\alpha_1 t} - 1)^{\frac{4}{3(n+1)}}dz^2\right] \quad (32)$$

Physical Aspects of the Model:

For the cosmological model (32), the physical quantities spatial volume V, Hubble parameter H, expansion scalar θ, mean anisotropy parameter A_m, shear scalar σ^2, matter energy density ρ_m, holographic energy density ρ_Λ and EoS parameter ω are obtained as follows:

Spatial volume,

$$V = (\alpha_2 e^{\alpha k t} - 1)^{\frac{3}{\alpha}}. \tag{33}$$

Hubble parameter,

$$H = \frac{1}{3}(H_1 + H_2 + H_3) = \frac{\alpha_1 \alpha_2 e^{\alpha k t}}{(\alpha_2 e^{\alpha k t} - 1)}. \tag{34}$$

Expansion scalar,

$$\theta = 3H = \frac{3\alpha_1 \alpha_2 e^{\alpha k t}}{(\alpha_2 e^{\alpha k t} - 1)} \tag{35}$$

Mean Anisotropy Parameter,

$$A_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 = \frac{2}{3}\left(\frac{n-1}{n+1}\right)^2. \tag{36}$$

Shear scalar,

$$\sigma^2 = \frac{3}{2}\Delta H^2 = \left(\frac{n-1}{n+1}\right)^2 \frac{\alpha_1^2 \alpha_2^2 e^{2\alpha k t}}{(\alpha_2 e^{\alpha k t} - 1)^2} \tag{37}$$

The matter energy density,

$$\rho_m = C_1 (\alpha_2 e^{\alpha k t} - 1)^{-\frac{6}{\alpha}}. \tag{38}$$

The holographic energy density,

$$\rho_\Lambda = \frac{3\alpha_1^2 \alpha_2^2 e^{2\alpha k t}}{(\alpha_2 e^{\alpha k t} - 1)^2}\left[\frac{k(\alpha_2 e^{\alpha k t} - 1)}{e^{\alpha k t}} + c - k\beta\right]. \tag{39}$$

Equation of state parameter using equation (24),

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$$\omega = \left[\frac{[(2\alpha - 3k\beta + (\delta - k)k\beta]\frac{\alpha_1^3\alpha_2^3 k e^{3\alpha k}}{(\alpha_2 e^{\alpha k} - 1)^3} - [(2\alpha + (\delta + k)\beta]\frac{\alpha_1^2\alpha_2^2 k e^{2\alpha k}}{(\alpha_2 e^{\alpha k} - 1)^2} + \beta\frac{\alpha_1^3\alpha_2^3 k e^{3\alpha k}}{(\alpha_2 e^{\alpha k} - 1)^3}}{(3\alpha - 3k\beta)\frac{\alpha_1^3\alpha_2^3 k e^{3\alpha k}}{(\alpha_2 e^{\alpha k} - 1)^3} + 3\beta\frac{\alpha_1^3\alpha_2^2 k e^{2\alpha k}}{(\alpha_2 e^{\alpha k} - 1)^2}} \right] \quad (40)$$

Conclusion:

Bianchi type-V cosmological model has been discussed in the frame work of $f(R,T)$ gravity proposed by Harkoet al. (Phys. Rev. D 84:024020. 2011) when the source for energy momentum tensor is minimally interacting holographic dark energy. The solution of the field equations has obtained by choosing the special form of deceleration parameter $q = -1 + \frac{k}{1+R^k}$ It is observed that in early phase of universe, the value

of deceleration parameter is positive while as , the value of . Hence the universe had a decelerated expansion in the past and has accelerated expansion at present which is in good agreement with the recent observations of SN Ia. Mean anisotropy parameter is found to be constant hence the model is anisotropic throughout the evolution. Hence we conclude that our model is resembles with models of Ghate&Sontakke [18].

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Higher Dimensional Anisotropic Universe without Big Smash Driven by Law of Variation of Hubble's Parameter

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Research Paper - Mathematics

ABSTRACT

Higher Dimensional Universe has been studied with $\omega < -1$ without Big Smash driven by Hubble's law of variation of parameter. It is investigated that if cosmic dark energy behaves like a fluid with equation of state $p = \omega \rho$, p and ρ being pressure and energy density respectively as well as generalized Chaplygin gas simultaneously, Big Rip or Big Smash problem does not arise even for equation of state parameter $\omega < -1$. Also the scale factor for the future universe is found to be regular for all time.

Keywords: Dark Energy, Big Smash, Higher Dimensional Universe.

Introduction:

Higher Dimensional anisotropic space times without big smash driven by law of variation of Hubble's parameter has been investigated. In section [1.1], The field equations for the Higher Dimensional space times in general theory of gravitation have been obtained. The solution of field equation have obtained by using the condition that the mean Hubble's parameter is related to average scale factor by Berman (1983) in section [1.2], while section [1.3] contains conclusion. Anil Kumar Yadav [27] have studied Bianchi-I anisotropic space times without big smash driven by law of variation of Hubble's parameter, Ghate etal. [30,31] have studied LRS Bianchi type-V anisotropic space times without big smash driven by law of variation of Hubble's parameter and Kaluza-Klein anisotropic

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space times without big smash driven by law of variation of Hubble's parameter

FIELD EQUATIONS:

The higher dimensional FRW metric for homogeneous and isotropic flat universe is given by

The higher dimensional FRW metric for homogeneous and isotropic flat universe is given by

$$ds^2 = -dt^2 + a^2(t)\left[dx^2 + dy^2 + dz^2 + dv^2\right], \quad (1)$$

where $a(t)$ is a scale factor and t represents the cosmic time, the fifth dimension v is the space coordinate.

The energy-momentum tensor for bulk viscous fluid in early universe is given by

$$T_j^i = (\rho + p)u^i u_j + pg_j^i, \quad (2)$$

where $\rho \rightarrow$ energy density, $p \rightarrow$ isotropic pressure, coefficient, $H \rightarrow$ Hubble's parameter, $g_{ij} \rightarrow$ metric tensor, u^i are the co-moving four velocity vectors which satisfy the condition

$$g_{ij}u^i u^j = -1, \text{ for } i = j = 0$$

and $$g_{ij}u^i u^j = 0, \quad \text{for } i = j = 1, 2, 3, 4. \quad (3)$$

Here the suffixes 0, 1, 2, 3, 4 represent the variables t, x, y, z, v respectively.

From equation (2), the components of energy-momentum tensor are

$$T_0^0 = -\rho, T_1^1 = T_2^2 = T_3^3 = T_4^4 = p. \quad (4)$$

Using equation (4), the matter tensor is given by

$$T_j^i = diag.(-\rho, p, p, p, p). \quad (5)$$

The Einstein's field equations are

$$R_j^i - \frac{1}{2}g_j^i R = -T_j^i, \quad (6)$$

where $R_j^i \rightarrow$ Ricci tensor, $R \rightarrow$, Ricci scalar, $T_j^i \rightarrow$ energy-momentum tensor.

With the help of equation (5), the Einstein's field equations (6) for the metric (1) are

$$\frac{\dot{a}^2}{a^2} = \frac{\rho}{6} \quad (7)$$

$$3\frac{\ddot{a}}{a} + 3\frac{\dot{a}^2}{a^2} = -p \quad (8)$$

The generalized mean Hubble's parameter H as

$$H = \frac{1}{4}(H_1 + H_2 + H_3 + H_4)$$

where H_1, H_2, H_3, H_4 represent directional Hubble's parameters in the directions of x, y, z and v axes respectively given by

$$H_1 = H_2 = H_3 = H_4 = \frac{\dot{a}}{a}$$

Thus Hubble's parameter is given by

$$H = \frac{\dot{a}}{a} \quad (9)$$

Using equation (7), equation (9) reduces to

$$\frac{\dot{a}^2}{a^2} = \frac{\rho}{6} = H^2 \quad (10)$$

Here $\left(\dot{}\right)$ dot represents the differentiation with respect to t.

The energy conservation equation which is the consequence of the field equations (6), is given by

$$T^{ij}_{;j} = 0 \quad (11)$$

where

$$T^{ij}_{;j} = \frac{1}{\sqrt{-g}}\frac{\partial}{\partial x^j}\left[T^{ij}\sqrt{-g}\right] + T^{jk}\Gamma^i_{jk}$$

which simplifies to

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$$\dot{\rho}+4\left(\frac{\dot{a}}{a}\right)(\rho+p)=0.$$

$$\Rightarrow \dot{\rho}=-4\left(\frac{\dot{a}}{a}\right)(\rho+p)$$

where $\dot{\rho}$ is the differentiation of ρ with respect tot .Equation (13) reduces to

$$\dot{\rho}=-4\frac{\dot{a}}{a}\left(\frac{\rho^{\frac{1+\alpha}{\alpha}}-A}{\rho^{\frac{1}{\alpha}}}\right),$$

where A is a constant.

Modifying above equation

$$\Rightarrow \quad \left[\frac{\alpha}{1+\alpha}\right]\left(\frac{\left[\frac{1+\alpha}{\alpha}\right]\rho^{\frac{1}{\alpha}}}{\rho^{\frac{1+\alpha}{\alpha}}-A}\right)\dot{\rho}=-4\frac{\dot{a}}{a},$$

On integration it leads to

$$\left[\frac{\alpha}{1+\alpha}\right]\log\left(\rho^{\frac{1+\alpha}{\alpha}}-A\right)=-4\log a+\log C \qquad (14)$$

At present time $t=t_0, a(t)=a_0, \rho(t)=\rho_0$.

With these values above equation (14) gives

$$\Rightarrow \quad \log C=\left[\frac{\alpha}{1+\alpha}\right]\log\left(\rho_0^{\frac{1+\alpha}{\alpha}}-A\right)+4\log a_0. \qquad (15)$$

Using this value of $\log C$,equation (14) leads to

$$\left[\frac{\alpha}{1+\alpha}\right]\log\left(\rho^{\frac{1+\alpha}{\alpha}}-A\right)=-4\log a+\left[\frac{\alpha}{1+\alpha}\right]\log\left(\rho_0^{\frac{1+\alpha}{\alpha}}-A\right)+4\log a_0.$$

$$\Rightarrow \quad \log\left(\frac{\rho^{\frac{1+a}{a}} - A}{\rho_0^{\frac{1+a}{a}} - A}\right)^{\left[\frac{a}{1+a}\right]} = \log\left(\frac{a_0}{a}\right)^4$$

$$\Rightarrow \quad \left(\rho^{\frac{1+a}{a}} - A\right)^{\left[\frac{a}{1+a}\right]} = \left(\rho_0^{\frac{1+a}{a}} - A\right)^{\left[\frac{a}{1+a}\right]}\left(\frac{a_0}{a}\right)^4$$

$$\Rightarrow \quad \left(\rho^{\frac{1+a}{a}} - A\right) = \left(\rho_0^{\frac{1+a}{a}} - A\right)\left(\frac{a_0}{a}\right)^{\frac{4(a+1)}{a}}$$

$$\Rightarrow \quad \rho^{\frac{1+a}{a}} = A + \left(\rho_0^{\frac{1+a}{a}} - A\right)\left(\frac{a_0}{a}\right)^{\frac{4(a+1)}{a}} \tag{16}$$

The dark energy is described by equation state parameter ω which is the ratio of pressure p and energy density ρ given by

$$\omega = \frac{p}{\rho} \tag{17}$$

The dark energy is described by equation state parameter which is the ratio of pressure and energy density given by

$$p = -\frac{A}{\rho^{1/a}} \tag{18}$$

Using equation (18) and (17) reduces to

$$\omega(t) = -\frac{A}{\rho^{\frac{1+a}{a}}} \tag{19}$$

At present time $t = t_0$. $\rho(t_0) = \rho_0$ and $\omega(t_0) = \omega_0$. one can get value of A from equation (19)

$$A = -\omega_0 \rho_0^{\frac{1+a}{a}} \tag{20}$$

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Substituting value of A in equation (16)

$$\rho^{\frac{1+\alpha}{\alpha}} = \rho_0^{\frac{1+\alpha}{\alpha}}\left[-\omega_0 + (1+\omega_0)\left(\frac{a_0}{a}\right)^{\frac{3(1+\alpha)}{\alpha}}\right]. \tag{21}$$

Taking $\left(\frac{1+\alpha}{\alpha}\right)^{th}$ power to both sides

$$\rho = \rho_0\left[-\omega_0 + (1+\omega_0)\left(\frac{a_0}{a}\right)^{\frac{3(1+\alpha)}{\alpha}}\right]^{\frac{\alpha}{(1+\alpha)}}. \tag{22}$$

with $\omega < -1$.

In homogeneous model of universe, the scalar field $\phi(t)$ with potential $v(\phi)$ has energy density

$$\rho_\phi = \frac{1}{2}\dot{\phi}^2 + v(\phi) \tag{23}$$

and pressure

$$p_\phi = \frac{1}{2}\dot{\phi}^2 - v(\phi). \tag{24}$$

Adding equations (23) and (24)

$$\dot{\phi}^2 = \rho_\phi + p_\phi.$$

Using equation (20), above equation leads to

$$\dot{\phi}^2 = \rho_\phi - \frac{A}{\rho^{1/\alpha}}.$$

Simplifying above equation

$$\dot{\phi}^2 = \frac{\rho^{1+\alpha/\alpha} - A}{\rho^{1/\alpha}}. \tag{25}$$

Using equations(20), equation (25) gives

$$\dot{\phi}^2(t) = \frac{\rho^{\frac{(1+\alpha)}{\alpha}} + \alpha_0 \rho_0^{\frac{(1+\alpha)}{\alpha}}}{\rho^{\frac{1}{\alpha}}} \qquad (26)$$

With the help of equation (22), equation (26) gives

$$\dot{\phi}^2(t) = \frac{\rho_0(1+\alpha_0)\left(\frac{a_0}{a}\right)^{\frac{4(1+\alpha)}{\alpha}}}{\left[-\alpha_0 + (1+\alpha_0)\left(\frac{a_0}{a}\right)^{\frac{4(1+\alpha)}{\alpha}}\right]^{\frac{1}{(1+\alpha)}}} \qquad (27)$$

From equation (27), it is observed that $\dot{\phi}^2 > 0$ (giving positive kinetic energy) for $(1+\alpha_0) > 0$ which represents quintessence and $\dot{\phi}^2 < 0$ (giving negative kinetic energy) for $(1+\alpha_0) < 0$ which represents phantom.

LAW OF VARIATION OF HUBBLE'S PARAMETER:

The Hubble's parameter and deceleration parameter plays important roll to show the physical relevancy of the model in cosmology. The first represents the present time scale of expansion while second represents that the universe is accelerating or decelerating.

As in Barman (1983), mean Hubble's parameter H is related to average scale factor $a(t)$ by following relation

$$H = Da^{-n} \qquad (2.1)$$

where D and n are positive constants.

From equations (9), and (2.1) give

$$\dot{a} = Da^{-n+1}$$

and $$\ddot{a} = -D^2((n-1)a^{-2n+1} \qquad (2.2)$$

The deceleration parameter is given by

$$q = -\frac{a\ddot{a}}{\dot{a}^2} \qquad (2.3)$$

Equations (2.2) and (2.3) lead to

$$q = (n-1). \tag{2.4}$$

Equation (2.4) shows that deceleration parameter q is constant. If $n>1$, q is positive resulting into standard model and if $0 \le n < 1$, the value of q lies between -1 and 0 resulting in to inflationary model,which matches with recent cosmological SNeIa and CMBR observations favoring that model is accelerating.

From equation (2.2)

$$\frac{\dot{a}}{a} = Da^{-n}. \tag{2.5}$$

On integration it gives

$$a = (nDt + C_0)^{\frac{1}{n}}, \tag{2.6}$$

where C_0 is a constant of integration.

From equation (2.6), it is clear that $a(t) \to \infty$ as $t \to \infty$ shows that universe is accelerating which support observational evidences of Ia Supernova (Riess*et al.*1998,Perlmutter*et al.*, 1999) and WMAP(Spergel, D. N. *et al.*2003,Page. L. *et al.*2003). It is seen that the model is free from finite time future singularity.

In this model Hubble's distance is given by

$$H^{-1} = (nt + D_0). \tag{2.7}$$

where $D_0 = \frac{C_0}{D}$ is constant.

From equation (2.7), if $t \to 0$ then $H^{-1} \to D_0$ and H^{-1} is found to be large and finite for large values of t. Thus in this model, galaxies will not disappearas $t \to \infty$ unlike the phantom models with future singularity, where galaxies are expected to vanish in near future singularity.

The horizon distance is obtained as

$$d_H = a(t)\int_0^t \frac{dt}{a(t)} \tag{2.8}$$

Using equation (6.3.6). equation (6.3.8) leads to

$$d_H = \frac{1}{D(n-1)}\left[(nDt + c_0) - D^{\frac{1}{n}}(nDt + c_0)^{\frac{1}{n}}\right] \tag{2.9}$$

whichgives

$$d_H > a(t), \quad \text{for} \quad t > \frac{(1 + D^{\frac{n}{(n-1)}} - c_0}{nD}$$

That is horizon grows more rapidly than the scale factor which implies colder and darker universe.

From equations (21) and (2.6). the energy density is given by

$$\rho = \rho_0\left[-\varpi_0 + (1+\varpi_0)\left(\frac{a_0}{(nDt + c_0)^{\frac{1}{n}}}\right)^{\frac{3(1+a)}{a}}\right]^{\frac{a}{(1+a)}} \tag{2.10}$$

Using $-\varpi_0 = |\varpi_0|$, equation (2.10) reduces to

$$\rho = \rho_0\left[|\omega_0| + (1-|\omega_0|)\left(\frac{a_0}{(nDt + c_0)^{\frac{1}{n}}}\right)^{\frac{3(1+a)}{a}}\right]^{\frac{a}{(1+a)}}$$

The energy density increases with increase in time for $\omega_0 < -1$ and decreases for $\omega_0 > -1$. Also

$\rho \to \rho_0 \left|1\varpi_0\right|^{\frac{a}{1+a}} > \rho_0$. which is finite as $t \to \infty$

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CONCLUSION:

Higher Dimensional anisotropic universe has been studied by the law of variation of Hubble's parameter proposed by Berman (1983). It is found that when cosmic dark energy behaves like fluid as well as generalized Chaplygin gas simultaneously then Big Smash problem does not arise unlike other phantom models. Singh *et al.*(2003) have established ω_0 for the model in the range $-2.4 < \omega_0 < -1.74$ up to 95% confidence level based on I Supernova data. For our model in particular $\alpha = 3$, $\rho_\infty = \rho$, $t \to \infty$ is found in the range $1.51\rho_0 < \rho_\infty < 1.92\rho_0$, which is analogous with the value obtained by Yadav (2011b) and also Ghate (2014) . Further the model is free from singularity as $a(t) \to \infty$ for $t \to \infty$. Also the horizon distance H^{-1} tends to finite value and diverge for large values of t . Therefore at present time galaxies will not disappear when $t \to \infty$ avoiding Big Smash singularity. The energy density increases with time indicating that the model has not finite future singularity. The results in our modelare analogous with the results obtained by Shrivastav (2005) and Yadav (2011), Ghate *etal* (2014).

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...लाभ प्रद आहे. इलेक्ट्रॉनीक दृकश्राव्य माध्यमाव्यतिरीक्त ... चार्ट , फळा यांव्दारे देखील संगीत शिक्षणातील संकल्पना ...स साह्य होते.

...

...निष्कर्ष- वरील काही महत्वपूर्ण तथ्यांवरून ...श्राव्य माध्यमांचे शास्त्रीय संगीतातील प्रचार - प्रसाराअंतर्गत योगदान ...यांने महत्वपूर्ण आणि संगीताच्या विकास / उन्नतीकरीता पुरक ...णि प्रेरक संगीताच्या आहे असे निष्कर्षास येते.

...र्भ ग्रंथ सूची -

१) डॉ. वंदना शर्मा - संगीत मेअनुसंधान एवं समस्याये ? ...ज्ञनाथ प्रकाशन

२) अरिहंत संगीत प्रश्नपत्र II और III : अरिहंत ...क्लीकेशन

३) संगीत मॅन्युअल नेट - मृत्युंजय शर्मा : ज्युपीटर सिरीज

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संगीताच्या प्रचारास आणि शिक्षणात दृकश्राव्य साधनाचे योगदान

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कुठल्याही कलेचो निर्मिती ही सौदर्यातुन होते. आपल्या कलेचा आस्वाद रसीकांनी घ्यावा आणि रसीकानी तेवoेयाच ताकदीने प्रतिसाद दयावा ही प्रत्येक कलावंताची इच्छा असते. ही कला तेचoेयाच ताकदीने प्रेक्षका समोर प्रसारीत करण्याचे महत्त्वाचे कार्य दृकश्राव्य साधणे करीत असतात.

आजची संगीत कला ही लोकाश्रयवार आधारीत आहे. त्यामुळे या कार्याक्रमाचे आयोजन विविध आधुनिक पध्दतीने होताने दिसुन येते. दिवसे दिवस संगीत क्षेत्रच काय तर सर्व क्षेत्रामध्ये वैज्ञानिक प्रगती बरोबरच सांगीतीक परिवर्तने सुध्दा होत आहे. ग्रामोफोन, टेप रेकार्ड, सिडी ते दुरदर्शन ते विविध चॉनल नवे इंटरनेट वरील विविध आधुनिक तंत्रज्ञानावर आधारीत सांगीतीक प्रसारणे याचा होत असलेला विकास क्रम संगीत शिक्षणाच्या दृष्टीने विचार करण्यासारखा आहे.

अगदी पुर्वीच्या काळी तिन तास चालणाऱ्या मैफीली चे सादरीकरण अगदी तीन मिनटावर आले असल्यामुळे वेळेच्या बंधनामुळे सादरीकरणात व शैलीमध्येही परिवर्तन होताना दिसुन येते. कारण काळाबरोबरच विज्ञान तंत्रज्ञानमध्ये झालेल्या बदलामुळे आधुनिक दृकश्राव्य साधनासोबत कार्यक्रम साधर करण्याचे कौशल्य संगीत शिक्षणाच्या माध्यमातुन नविन कालावंताजवळ असणे तितकेच गरजचे झालेले आहे.

स्वांतत्र पुवं काळात संगीत शिक्षणासाठी पं.पलुस्कर व पं. भातखंडे यांच्या योगदानामुळे व त्यांनी निर्माण केलेल्या शिष्य परिवारामुळे संगीत कलेच । प्रसार संपूर्ण भारत भर झाला व त्यामुळे अनेक कलावंत, शिक्षक, विद्यार्थ्यी इत्यादी सर्वांच्या सांगीतीक शिक्षणाच्या कक्षात जाणिवा विस्तृत झाल्या यातून समजामध्ये संगीत कलेची ओळख व प्रचार व प्रसार झाला. यामध्ये दृकश्राव्य साधनांचे

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मोठे योगदान आहे.

विज्ञानाच्या विकासामुळे शास्त्रीय संगीत वैचारिक गोंधळातुन वाद काडीत वेगळया टप्यावर येऊन पोहचले आहे. दुरदर्शन ते विविध चॉनल नवे इंटरनेट वरील विविध प्रचार व प्रसार माध्यमामुळे प्रत्येक घरान्याची गायकी सुलभतेने उपल्बध होतांना दिसते. शास्त्रीय संगीताला प्रायोजक मिळतांना दिसुन येतात. संध्याचे युग हे संगणकाचे असल्यामुळे विविध गायक वादकांचे कार्यक्रम विविध घराण्याची गायकी चर्चा भुलाखती प्रकाशीत साहित्य हे या दृकश्राव्य साधनामुळे सहज ऐकणे सोयीचे झाले आहे.

दुरदर्शनावरील अनेक संगीतीक कार्यक्रम तसेच विविध चॅनल वरील रीयालीटी शो तसेच इलेOEट्रानीक उपकरणे विविध इलेOEट्रानीक वादय नव नवीन विकसीत झालेली तंत्र यामुळे माहीती व तंत्रज्ञानाचा स्फोट होऊन संगीत शिक्षण क्षेत्रामध्ये फार मोठा बदल घडवुन आलेला आहे. या बदलात दृकश्राव्य साधनाचा फार मोठा वाटा आहे. हे निरवीवाद मान्य करावे लागेल.

म्हणुन संगीत मग ते कुठलेही असो म्हणजेच लोक संगीत असो वा सुगम संगीत , शास्त्रीय संगीत या सर्वाच्या प्रचार प्रसारामध्ये दृकश्राव्य साधनाचा फार मोठा वाटा आहे .

सारांश

दृकश्राव्य साधनामुळे संगीत शिक्षण क्षेत्रच नव्हे तर त्याच्या विविध शाखेचा प्रचार प्रसार होऊन त्यामध्ये खुप मोठे क्रांतीकारी बदल घडुन आलेले आहे. त्यासोबतच उपरोOEत चांगल्या बाजुचा विचार करतांना ओरीजनल गोष्टीला सुध्दा पारखे व्हावे लागत आहे. इलेOEट्रानीक वादय नव नवीन विकसीत झालेली तंत्र यामुळे माहीती व तंत्रज्ञानाचा स्फोट होऊन संगीत शिक्षण क्षेत्रामध्ये फार मोठा बदल घडवुन आलेला आहे. या बदलात दृकश्राव्य साधनाचा फार मोठा वाटा आहे.

संदर्भ ग्रंथ

१ संगीत विशारद लक्ष्मीनारायण गर्ग
२ संगीत निबंधावली किरण पाटक
३ संगीत मासीक हाथरस कार्यालय
४ संगीत कला विहार अंक अ.भा.गं.मंडळ मिरज.

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आकाशवाणी – दूरदर्शन : संगीत

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प्रसार माध्यमांमधे रेडिओ हे आधीही प्रभावी माध्यम होते, तसेच आजही आहे, किंबहूना आज जास्त आहे. त्याचे कारण म्हणजे रेडिओची वाढलेली 'स्टेशन्स्'... रेडिओ मिरची, ९८.२ आदी आदी. त्यामधे आकर्षकरित्या निवेदन करणोर रेडिओ जॉकी पूर्वी (AIR) ऑल इंडिया रेडिओ हया प्रभावी माध्यमा मार्फत देशातील वर्तमान स्थिती, मुलाखती, सांस्कृतिक, सामाजिक, वैज्ञानिक प्रगती, सरकारची धोरणे, आदी विषयांवर प्रकाश टाकल्या जात असे, प्रत्येक गोष्ट सामान्यांपर्यंत रेडिओ मार्फत पोहचविण्याचे कार्य रेडिओ मार्फत होत असे. त्यानंतर ८० च्या दशकात तंत्रज्ञा क्रांतीने जन्म घेतला, दूरून ऐकू येणारा आवाज, घराघरा दिसू लागला, या काळात रेडिओचे महत्व थोडे क झाले होते. दूरदर्शनच्या माध्यमातून त्या–त्या ठिकाण परिस्थीती, नेते, पुढारी मंडळी, त्यांची भाषणे, साहित्यि कवी, कलावंत, वैज्ञानिक, शेतकरी मंडळी यांचे प्रत्य दर्शन होऊ लागले. मनोरंजन होऊ लागले. रेडिओ दूरदर्शन या माध्यमांधून दर्जेदार प्रस्तुतीकरणामु शैक्षणिक, सामाजिक दर्जा उचांवू लागला. ही परिस्थि १९८० ते २००० पर्यंत उत्तम होती.

२००० पासून नविन तंत्रज्ञानाद्वारे अमुल बदल होणे सुरू झाले. दूरदर्शन हे एकच न रा अनेक वाहिन्या उदयास येऊ लागल्या. त्या द्वारे लो मनोरंजन होईल याकडे अधिक लक्ष दिल्या गेले, अपेक्षितही होते. आज तर प्रत्येक पैलूवर प्र टाकणारे स्वतंत्र चैनल्स् (वाहिनी) आहेत. बात स्वतंत्र चैनल, खेळाचे, संगीताचे, मनोरंजनाचे शेकडो वाहिन्यांनी आज आपण वेढले गेलो

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1. Voicing Diaspora through Myth, Memory and Desire: Meena Alexander's Manhattan Music

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Abstract

The present global world has given birth to new transnational societies in the host countries. Residing there and trying to assimilate in the new nations and cultures the immigrant subjects experience an odd feeling of exile and alienation. Their dislocation- physical, psychological, cultural- surges their souls with a sense of fragmented self, a craving for homeland, perpetual memory of the past augmented with a desire to return to roots rendering them alienated souls hovering like shadows over 'imaginary homelands'.

This paper attempts to illustrate Meena Alexander's representation the agony of dislocation; life in exile, and struggle of immigrants towards solidarity and assimilation in her novel 'Manhattan Music'.

Keywords: South-Asian Diaspora, exile, myth, memory, homeland, assimilation

The term 'Diaspora' has its obvious connotations to the historical Jewish experience of dispersal. Though, in the modern context this limited view does not suffice to include the whole phenomenon of diaspora. The multiplication of the process of migration in today's globalized world has made the term diaspora acquire a multifaceted, multilayered and more complex meaning. It has spread across various branches of learning occupying a place within disciplines like Sociology, Anthropology, Political Science, Demography, Economics, Cultural Studies and Literature etc. In the present times, Globalization with its modern technology and aviation facilities has set a huge population across the world on move in search of better prospects in careers and businesses. The number of emigrants from Asia and Africa to Europe and America has been multiplied in the last couple of decades. This migrancy has ushered in a new global society, a transnational community though not without its new problems. It has brought about both the universalisation and the fragmentation and multiplication of cultures and identities. The shared living of this immigrant community in the host country, their shared imagination of homeland, a sense of shared culture and religion and a shared desire for returning to home are the factors that together constitute the diaspora life.

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Despite numerous definitions and long debates, one of the key features of diaspora literature is the play of 'imaginary homeland', memory of what was once a 'home' and the inevitable indulgence of immigrant subjects in the 'myths' of homeland. Robin Cohen has given a consolidated list of 'common features' of a diaspora stressing "a collective memory and myth about the homeland, including its location, history and achievements" (Cohen 1996, p. 515). One of the important features of diasporic experience is "a strong attachment to and desire for literal return to a well-preserved homeland" (Clifford, p.305). The ardent longing for return to home is sometimes materialized, however, only to aggravate the pangs of dislocation and exile. As Avtar Brah writes, "What is home? On the one hand, 'home' is a mythic place of desire in the diasporic imagination..." (Brah 1996, p.192). However, the notion of home has been challenged by some critics like Stuart Hall when he points out that 'the links between these communities and their 'homeland' or the possibility of a return to the past are much more precarious than usually thought.' (Hall 1993, 355)

Meena Alexander, one of the prominent south-Asian diaspora writers, has depicted the agony of dislocation, life in exile, and the struggle of immigrants towards solidarity and assimilation. Born and raised in Kerala and later in Sudan, Alexander immigrated to the United Kingdom for higher education and then settled in the United States. Through her marriage with David Lelyveld, her multiple border crossings and her career at universities in India and USA, she knows diaspora from her firsthand experiences. Her literary works, both poetry and fiction delineate her own lived life with 'multiple anchorages'.

Through her novel Manhattan Music Alexander significantly comments on the impact of transplantation from natal to post-migration spaces in the lives of immigrant characters-Sandhya, Sakhi, Draupadi, Jay, Ravi, and Rashid. All these characters, with their different origins and cultural backgrounds, jostle each other on an alien land. They are brought together by dint of their shared experiences of crossing borders, attempting to adjust in the new societies, struggling through married and social lives and eventually aspiring to reach assimilation with the new cultures.

Sandhya, an Indian girl born in Tiruvella, marries an American Jewish man Stephen, struggles through her turbulent life to find her own space, to gain an identity for herself. The free spirits of Sandhya did not surrender to the pressing urges of her mother; instead she loves a young man Gautam Reddy, a supporter of leftist ideology and movement. After Gautam's tragic death she moves to Nainital to find consolation by engaging her in further education. It is here that she meets Stephen Rosenblum who had been to India on a tour. They get attracted to each other and enter the marriage bond. Now Sandhya Rosenblum, with her new identity crosses the

borders entering a New World where unfortunately she finds it difficult to keep body and soul together. "This was the world Stephen had brought her to, but he himself was oddly absent from it" (Alexander 1997, p.39)

Sandhya suffers from loneliness having nothing substantial to do or no one to share her emotions. Stephen, though liberal and caring, but quite busy in his work, cannot give sufficient time to his wife. This results in tearing Sandhya away from him and from herself too. In contrast to the "memories of shared emotion" (Alexander 1997, p. 38) of their early days, Sandhya only finds that "now she couldn't even speak openly with him, locked as she was into a world she felt she had not chosen" (Alexander 1997, p. 38). Stephen's decision to remain "absent" from her life to give her space and to encourage her self-sufficiency does not solve her problems that she faces due to her "dark femaleness" (Alexander 1997, p. 39) in the American society. The growing emptiness catches upon her mind and she is often lost in nostalgia, remembering her life back in Tiruvella and Hyderabad, her lost love- Gautam, his images haunting her dreams every night. She says, trying to expresses her desperate situation, to Draupadi, "Thought when I married Stephen it would all work out. New life, new memories. Instead all I have are these voices." (Alexander 1997, p. 199)

A dramatic change takes place in Sandhya only when she meets Rashid el Obeid, an Egyptian post-doc fellow at Columbia, whom she was attracted to with body and spirit, in whom she found a release to her suffocations- physical, emotional and spiritual too. Rashid too finds something in Sandhya extraordinary and gets lured to her, trying to relocate himself in Cairo:

> "Shutting his eyes, he imagined himself on a boat on the Nile, the tall rushes, the dark soil of Upper Egypt cut from him by rushing water. Both he and Sandhya were foreigners in America, they would cradle each other. He would cast her afloat on the Nile and with her; he would sail on the Ganges." (Alexander 1997, p.76)

This relationship gives both of them a feeling of being at home- an imaginary past recalled to present by memories- memories of birth, childhood, growing up, falling in love, crossing borders and being exiled, even alienated by the arid present.

When her father is hospitalized due to lung infection, Sandhya wants to be with him. She is tormented by the demand of the situation when she needed to be in two places at once. However, her visit to her 'home', place of her birth proves to be more agonizing, intensifying the torments of her dislocation, making her think of the unhappy married life in an alien city. Back in Manhattan, Sandhya tries to search a meaning for her real self- her womanhood, her motherhood, her married life, her love for Rashid and above all her aspirations for 'wholeness'. She expresses her [illegible] desire to Rashid, "And I felt you and I should live together, make a

house" (Alexander 1997, p.154). After tragic distancing from Rashid, in a desperate mood she attempts suicide at her friend Draupadi's apartment.

It is only after all these oscillatory physical, emotional and spiritual experiences that Sandhya could further her 'self' towards a more concrete ground of assimilation and solidarity. It dawns upon her that now she couldn't just lean on others. She had to trust herself if she wanted to go on. 'There was a place for her here, though what it might be she could never have spelled out. And she, who had never trusted words very much, knew she would live out her life in America.' (Alexander 1997, p.228)

Another woman character in the novel is Daupadi Dinkins, from Indo-Caribbean diaspora and a performing artist in mix-media. She is viewed as an alter-ego of Sandhya, as she finds solace in her company, in the free way Draupadi moves in the new world. The character of Draupadi, in a good contrast with that of Sandhya, focuses on the other and perhaps more complex side of diaspora – its multi-ethnic, multi-racial, multi-lingual, multi-religious side with all its shames, humiliations, horrors and sufferings. The story of mythical Draupadi is very aptly interwoven by Meena Alexander, highlighting the age-old sufferings of exile. Draupadi talks anxiously about her parents choosing this name for her:

> "Why they named me Daupadi I cannot tell. What did they know of the goddess born of fire, wife of the five Pandavas, she who rode an elephant, was humiliated in the court of kings, survived a battlefield, lived out her life in exile, then raced into the wind, atop a tiger, a lotus blossom in one hand, a sword in the other?" [Italics original] (Alexander 1997, p. 88)

Why, she wants to ask her parents, they couldn't have named her Dorothy? This name would have fitted more to her in the land of exile.

Sakhi, born and brought up in India like her cousin Sandhya, provides us with another facet of diaspora. Unlike Sandhya, she has married Ravi, an Indian businessman in New Brunswick. She is witness of many incidents of racism like stoning, abusing, robbing and even lynching. Sakhi, after her terrible experience of stoning, expresses her grief:

> "What if crossing a border one changed color, shape even? And this happened to every single human being in the world? What if metamorphosis were built into the bodily system? (Alexander 1997, p. 207)

All these characters belonging to different lands, different homes, worshipping different gods, following different cultures, speaking different languages face the problems which to a greater extend are similar in kind and degree. Men and women from Japan, Egypt, Trinidad, Fiji,

Caribbean, India and what not try to assimilate making their togetherness more endurable if not enjoyable.

The Global Village becomes a stage on which players of the Diaspora enact their roles, camouflaging through varied cultures, languages, religions, and nations. In the fray, they lose their real identities, acquiring new hybrid, hyphenated ones, and are perpetually lost in the fond memories of the homeland, stirred by an ardent desire to return 'home'. This sense of not belonging and a consequent longing for home perpetuate the age-old myths allowing and disallowing the souls of the immigrants to strike their dull roots in alien lands. Alexander wields, with a deft mastery, the Indian myth of Draupadi of Mahabharata to bring out the tragic play of perpetual memory and desires tormenting the souls of Sandhya, Sakhi, and Draupadi all living in exile.

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Crystal Structure Of Cr^{3+} Ions Substituted Co-Ferrite Nanoparticles

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ABSTRACT

A series of polycrystalline spinel ferrite having the chemical formula $CoCr_xFe_{2-x}O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) were synthesized by using sol-gel auto combustion method and studied by using X-ray diffraction (XRD) measurements. The XRD analysis reveals single phase cubic spinel structure of synthesized samples. The particle size of was found by XRD and scanning electron microscopy (SEM) technique confirms the nanocrystalline nature of the samples.

Keywords: Sol-gel, X-ray diffraction, structural properties

I. INTRODUCTION

Ferrite materials are metal oxides have high electrical resistivity, low eddy current losses and convincingly low costs coupled with their potential microwave applications such as circulators, isolators and phase shifters. Now a day nanosized ferrite materials have been widely used to prepare many electromagnetic devices such as inducters, converters, phase shifters and electromagnetic wave absorbers [1].

On the basis of crystal structure, ferrites are grouped into three important classes, namely spinel ferrite, garnet and hexa-ferrite [2]. Spinel ferrites are represented by the formula AFe_2O_4, where A is a divalent metal ion. The crystal structure of ferrite consists of two interstitial sites, tetrahedral (A) and octahedral (B) sites, in which cations are occupied. So that it is essential to know the crystal structural of ferrite material. Ferrites made from nanoparticles can show different properties unlike those observed in bulk material. The structural properties of these materials can be attributed to the small size, a large surface to volume ratio, cation distribution, concentration of localized electric charge carriers, and stoichiometry.

The identification of new materials with improvement in properties or new processing techniques to improve the performance of existing materials, along with the economical advantages, is always a matter of interest to researchers. The fabrication of spinel ferrites nanoparticles has been the subject of intense research interest due to their excellent magnetic, electrical and dielectric properties [3].

According to literature, several researchers focused only few properties of ferrite material, however the structural, electrical and dielectric properties of Cr^{3+} substituted cobalt ferrite has not been investigated together in detail by the researchers [4-6].

Cr^{3+} with antiferromagnetic nature is known for achieving good control over electric as well as dielectric parameters in developing technologically important materials. The substitution of Cr^{3+} ions for Fe^{3+} ions will improve the properties marked similarly to that of nonmagnetic substitution. In the present study, we synthesized $CoCr_xFe_{2-x}O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) ferrite nanoparticles by using the sol-gel auto combustion method and investigated the consequent

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changes on crystal structure of the Cr^{3+} substituted cobalt ferrite.

II. EXPERIMENTAL

For the synthesis of $CoCr_xFe_{2-x}O_4$ (where x = 0.0 to 1.0 in the step of 0.2) by sol-gel auto combustion method, calculated quantities of metal nitrates were dissolved together in a 100ml of deionised distilled water to get clear solution. An aqueous solution of citric acid then added to the metal nitrate solution. The molar ratio (citric acid to the total moles of nitrate ions) was adjusted to 1:3. A small amount of liquid ammonia (NH_3) was added drop wise into the solution so as to maintain pH value to about 7. A continuous stirring and heating the solution at 90°C on hot plate with magnetic stirrer until it becomes a viscous gel. The process of mixing till continued to burn the material in the powder form. The complete process is shown with in the flow chart Figure 1. The powder was annealed in air at temperature 500°C for 6h with heating rate 50°C per min to obtain a spinel phase. The final product is then grinded and subjected to further study.

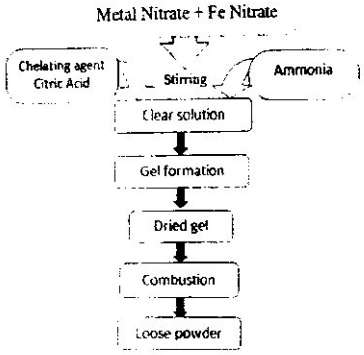

Figure 1. Flow chart shows the stages involved in preparation of spinel ferrite by sol-gel auto combustion method

III. RESULT AND DISCUSSION

3.1. Structural analysis:

3.1.1. X-ray diffraction and lattice constant

The X-ray diffraction (XRD) patterns of the typical samples (x = 0.6, 0.8, 1.0) of $CoCr_xFe_{2-x}O_4$ nanoferrite system were shown in Figure 2.

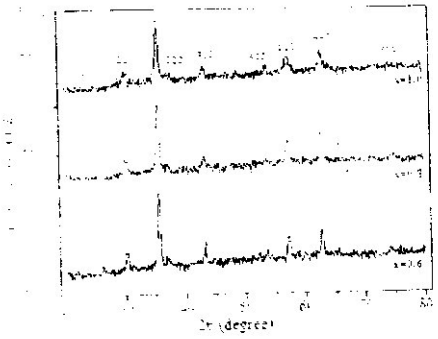

Figure 2. Typical XRD patterns for x= (0.6, 0.8, 1.0) of $CoCr_xFe_{2-x}O_4$ nanoferrite system

The XRD patterns of all the Cr substituted cobalt ferrites shows single phase cubic spinel structure. The XRD shows the reflection such as (111), (220), (311), (222),(400), (422), (511), (440), (533) which belongs to cubic spinel ferrite. All the Braggs reflections peaks are allowed peaks have been indexed without any impurity peaks. The strongest reflection has come from (311) plane that indicates spinel phase.

Lattice constant (a) of all composition was calculated by using the formula,

$$a = d\sqrt{N} \quad Å$$

where $N = h^2 + k^2 + l^2$ and 'd' is the interplaner spacing.

The variation of lattice parameter with Cr^{3+} compositions lies in between 8.3939 Å to 8.3371 Å is listed in Table 1. The lattice parameter was found to decrease linearly with increasing Cr^{3+} content x. This linear variation indicates that the Co-Cr ferrite system obeys Vegard's law [7]. A similar behavior of lattice constant with dopant concentration was observed by several investigators in various ferrite systems. The decrease in lattice parameter with increase in Cr^{3+} content can be explained on the basis of relative ionic radii of Cr^{3+} (0.63 Å) and Fe^{3+} (0.64 Å) ions. Calculated lattice parameter for Cobalt ferrite ($CoFe_2O_4$) was in good agreement with the standard value (8.391 Å) reported from ICSD data. As Cr^{3+} ions have small ionic radii than that of Fe^{3+} a partial replacement of Fe^{3+} ions by Cr^{3+} ions results in a decrease in lattice parameter.

There exists a correlation between the ionic radius and the lattice constant, the increase of the lattice constant is proportional to the increase of the ionic radius [8, 9].

3.1.2. Particle size

Using the literature sol-gel method is the only method which has resulted in Co-Cr ferrites with such a very small particle size. The average particle size (t) of all sample compositions has been calculated from full width at half maximum (FWHM) of broadening of the most intense peaks (311) using the following Debye-Scherrer formula [10].

$$t = \frac{k\lambda}{\beta \cos\theta} \quad \text{A}$$

where, λ is the X-ray wavelength (=1.5405Å) of radiation, **k** is the shape factor with typical value 0.94, β is the line broadening at FWHM of the diffraction peak and θ is the diffraction angle in radian.

The values of particle size obtained from XRD data and SEM (Table 1) are in response to the increase in Cr^{3+} ions substitution. The average particle sizes is found in the range ~14 to 28 nm which are close to the results obtained from SEM images and good agreement with report of Sonal Singhal et.al. [11]

Table 1. Lattice constant, particle size, of $CoCr_xFe_{2-x}O_4$ nanoferrite system

Ferrite composition	Lattice constant 'a' (Å)	Particle size 't' (nm)	
		XRD	SEM
$CoFe_2O_4$	8.3939	27.80	27
$CoCr_{0.2}Fe_{1.8}O_4$	8.3812	20.85	20
$CoCr_{0.4}Fe_{1.6}O_4$	8.3722	16.68	18
$CoCr_{0.6}Fe_{1.4}O_4$	8.3604	20.85	20
$CoCr_{0.8}Fe_{1.2}O_4$	8.3485	20.85	20
$CoCr_{1.0}Fe_{1.0}O_4$	8.3371	13.90	14

3.1.3. Bond length

Bond lengths R_A and R_B are the shortest distance between A-site and B-site cations with the oxygen ion respectively. The variation of the bond length R_A and R_B of $CoCr_xFe_{2-x}O_4$ nanoferrite system calculated by the equation [12] and listed in Table 2.

The values R_B are greater than R_A indicates that the B-site cations Co^{2+} are closer to oxygen O^{2-} ions exert more attractive force. The value of bond lengths R_A and R_B decreases from 1.904 to 1.892 Å and 2.048 to 2.036 Å respectively as Cr^{3+} ion content increases. The value of B-site Cr^{3+} ions is greater than A-site Co^{2+} ions. This may be explained on the basis of difference in ionic radii of constituent ions Cr^{3+} (0.63 Å) and Co^{2+} (0.82 Å).The behavior of bond lengths is attributed to variation of lattice constant with Cr content x [13].

3.1.4. Tetrahedral and octahedral bond edges

The bond length of tetrahedral (A) site 'd_{AX}' and octahedral [B] site 'd_{BX}', tetrahedral edge 'd_{AXE}', shared octahedral edge 'd_{BXE}' and unshared octahedral edge 'd_{BXEU}' of $CoCr_xFe_{2-x}O_4$ nanoferrite system were calculated by using the values of lattice constant 'a' and oxygen positional parameter 'u', in the standard equations.

The calculated values are depicted in Figure 3. The Figure 3 indicates that the tetrahedral bond length d_{AX} and octahedral bond length d_{BX} decrease as Cr^{3+} content x increases. Also shows that the tetrahedral edge 'd_{AXE}', 'd_{BXE}' unshared octahedral edge'd_{BXEU}' does not vary much with composition while shared octahedral edge 'd_{BXE}' decreases [14]. The observed behavior is attributed to decrease in the lattice constant with the Cr content (x) due to smaller ionic radii of Cr^{3+} ions.

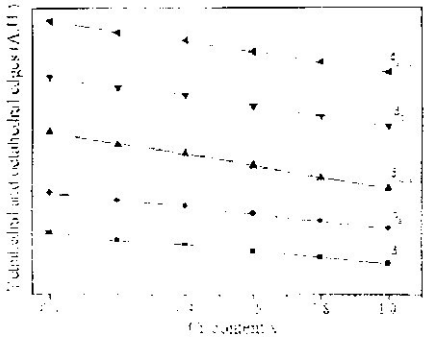

Figure 3. Tetrahedral and octahedral bond edges with Cr content x of $CoCr_xFe_{2-x}O_4$ nanoferrite system

3.1.5 Scanning electron micrographs (SEM) analysis

SEM was used to investigate the change of microstructures of the synthesized $CoCr_xFe_{2-x}O_4$ nanoferrite powder samples with Cr content x. The prepared ferrite powders were recorded by using scanning electron microscope (JSM-6360 model) at Dept. of Physics, SPPU, Pune. The micrograph of the recorded typical sample (x=0.8) is as shown in Figure 4.

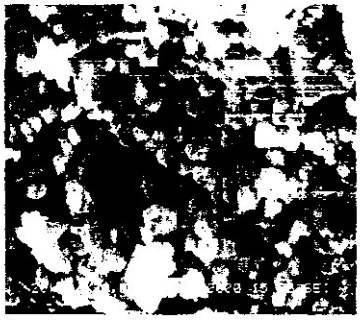

Figure 4. Typical SEM image of $CoCr_xFe_{2-x}O_4$ nanoferrite system

From the SEM images, it is observed that the prepared samples are porous in nature. It should also be noted that, though sintering temperature 500°C is responsible for small amount of pores in SEM images revels that the sintering is done in a satisfactory manner without loss of Cr ions in all samples. The effect of increasing Cr^{3+} content on the investigated samples is the enhancement of the grain growth as seen from the SEM [15]. Uniform grains are progressively increased with increasing Cr^{3+} content x and the ferrite samples exhibit an aggregated continuous grain growth. The particle size determined from SEM images is in the range from 14 to 27nm by linear intercept method [16] and the values are given in Table 1.

IV. CONCLUSION

The substitution of Cr^{3+} ions in Co-ferrite has been successfully investigated by sol-gel auto combustion method. Powder XRD, SEM data indicate clearly the information of ultrafine single phase cubic spinel structure of synthesized Co-Cr ferrite material. The particle size obtain in between 14 to 28 nm. Bond length, tetrahedral and octahedral bond edges are directly depends on lattice constant.

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Structural Investigation of Cr^{3+} ions substituted Cu-ferrite nanoparticles

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ABSTRACT

A series of polycrystalline spinel ferrite having the chemical formula $CuCr_xFe_{2-x}O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) were synthesized by using sol-gel auto combustion method and studied by using X-ray diffraction (XRD) measurements. The XRD analysis reveals single phase cubic spinel structure of synthesized samples. The particle size was found by XRD and scanning electon microscopy (SEM) technique confirms the nanocrystalline nature of the samples. Bond length and Tetrahedral and octahedral bond edges also calculated from structural analysis.

Key words: Sol-gel, X-ray diffraction, Structural properties

INTRODUCTION

Ferrite materials are metal oxides have high electrical resistivity, low eddy current losses and useful in microwave applications such as circulators, isolators and phase shifters. Now a day nano sized ferrite materials have been widely used to prepare many electromagnetic devices such as inductors, converters, phase shifters and electromagnetic wave absorbers [1]. On the basis of crystal structure, spinel ferrites are represented by the formula AFe_2O_4, where A is a divalent metal ion. The crystal structure of ferrite consists of two interstitial sites, tetrahedral (A) and octahedral [B] sites, in which cations are occupied and nanoparticles from can shows different properties unlike those observed in bulk

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material. The fabrication of spinel ferrites nanoparticles has been the subject of intense research interest due to their excellent structural, magnetic, electrical and dielectric properties [2]. The properties of nanoparticles mostly depend on synthesis method. Therefore now a days different methods are being used for synthesis nanomaterials such as co-precipitation method, hydrothermal method, microemulsion method, sol-gel autocombustion method, so no chemical reaction method [3-7]. Among these methods sol-gel autocombustion method is used to synthesis of copper ferrite nanoparticles. In the present paper, we synthesized $CuCr_xFe_{2-x}O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) ferrite nanomaterial by using the sol-gel autocombustion method and investigated the consequent changes on structure of ferrite.

METHODOLOGY

$CuCr_xFe_{2-x}O_4$ (where x = 0.0 to 1.0 in the step of 0.2) synthesized by sol-gel auto combustion method. Calculated quantities of required metal nitrates were dissolved together in a 100ml of deionised distilled water to get clear solution. An aqueous solution of citric acid then added to the metal nitrate solution. The molar ratio was adjusted to 1:3. A small amount of liquid ammonia (NH_4) was added drop wise into the solution so as to maintain pH value. The process of mixing till continued to burn the material in the powder form. The final product is then grinded and subjected to further study.

RESULTS AND DISCUSSIONS

The X-ray diffraction (XRD) patterns of the samples (x=0.0 to 1.0 in the step of 0.2) of $CuCr_xFe_{2-x}O_4$ nanoferrite system shown in Fig.1.

The XRD patterns of all the Cr substituted copper ferrites shows the reflection such as (111), (220), (311), (222), (400), (422), (511), (440), (533) which belongs to cubic spinel ferrite. All the Braggs reflections peaks are allowed peaks have been indexed without any impurity peaks. The strongest reflection has come from (311) plane that indicates spinel phase.

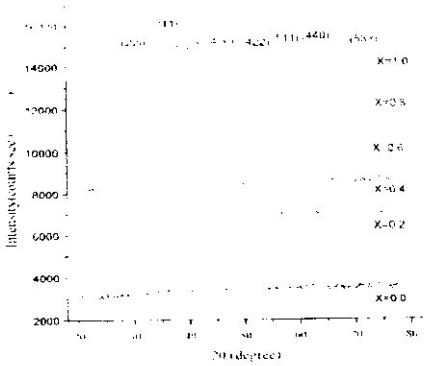

Fig.1. X-ray diffraction patterns of the $CuCr_xFe_{2-x}O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, 1.0) nanoparticles

1. Lattice constant

Lattice constant (a) of all composition was calculated by using the formula,

$a = d\sqrt{N}$ Å

where $N = h^2 + k^2 + l^2$, d is the interplanar spacing.

The variation of lattice parameter with Cr^{3+} compositions lies in between 8.3886 Å to 8.3057 Å is listed in **Table 1**.

2. Particle size

The average particle size (t) of all sample compositions has been calculted from full width at half maximum (FWHM) of broadening of the most intense peaks (311) using Debye-Scherrer formula [10].The values of particle size obtained from XRD data and SEM (Table 1) are close to the results obtained from SEM images.

3. Bond length

The bond length R_A (is the shortest distance between A site cations and oxygen ion) and R_B (is the shortest distance between B site cations and oxygen ions) have been calculated by the equation [11] and listed in Table 2.

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Table 1: Variation in Lattice constant and Particle size of $CuCr_xFe_{2-x}O_4$ nanoferrite

Ferrite composition	Lattice constant 'a' (Å)	Particle size 't' (nm)	
		XRD	SEM
$CuFe_2O_4$	8.388o	28.80	37
$CuCr_{0.2}Fe_{1.8}O_4$	8.3382	26.58	3
$CuCr_{0.4}Fe_{1.6}O_4$	8.3343	25.68	27
$CuCr_{0.6}Fe_{1.4}O_4$	8.3211	23.56	25
$CuCr_{0.8}Fe_{1.2}O_4$	8.3109	21.43	22
$CuCr_{1.0}Fe_{1.0}O_4$	8.3057	19.90	18

Table 2: Bond length, tetrahedral and octahedral edge of $CuCr_xFe_{2-x}O_4$ nanoferrite

Cr Content x	Bond length (A)		Tetrahedral and octahedral edges (A)				
	R_A	R_B	d_{AA}	d_{BA}	d_{AAE}	d_{BAE}	d_{BAU}
0.0	1.903	2.048	1.282	1.865	1.995	3.077	2.797
0.2	1.896	2.041	1.276	1.878	1.988	3.067	2.785
0.4	1.891	2.035	1.250	1.872	1.982	3.057	2.777
0.6	1.888	2.032	1.221	1.865	1.975	3.046	2.767
0.8	1.886	2.029	1.195	1.859	1.969	3.037	2.758
1.0	1.884	2.028	1.174	1.855	1.963	3.029	2.751

It is evident from **Table 2**. that the bond length R_A and R_B decreases with Cr^{3+} ions content x. The decrease in bond length can be attributed to the decrease in lattice constant 'a' with Cr^{3+} ions content x.

4. Tetrahedral and octahedral bond edges

The bond length of tetrahedral (A) site 'd_{AA}' and octahedral [B] site 'd_{BA}', tetrahedral edge d_{AAE}, shared octahedral edge 'd_{BAE}' and unshared octahedral edge 'd_{BAU}' of $CuCr_xFe_{2-x}O_4$ nanoferrite system were calculated by using the values of lattice constant 'a' and oxygen positional parameter 'u', in the standard equations and values are depicted in **Table 2**.

5. Scanning electron micrographs (SEM) analysis

The micrograph of the recorded typical sample (x= 0.6) is as shown in **Fig. 3**. From the SEM images, it is observed that uniform grains are progressively increased with increasing Cr^{3+} content x and the ferrite sample exhibit an aggregated continuous grain growth. It can be also observed that the prepared samples are amorphous and porous in nature. The particle size determined from SEM images by linear intercept method [12] and the values are given in **Table 1.**

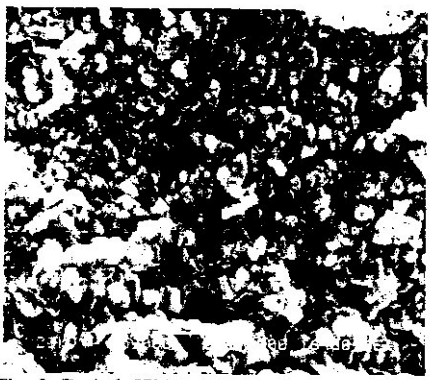

Fig. 3: Typical SEM image (x=0.6) of $CuCr_xFe_{2-x}O_4$ nanoferrite system

CONCLUSION

In conclusion, the substitution of Cr^{3+} ions in Cu-ferrite has been successfully investigated by sol-gel autocombustion technique. Powder XRD, SEM data indicate clearly the information of ultrafine single phase

cubic spinel structure of synthesized Cu Cr ferrite material. The particle size obtains in between 19.90 to 28.80 nm. Bond length, tetrahedral and octahedral bond edges are directly depends on lattice constant

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