

**Indapur Taluka Shikshan Prasarak Mandal's**  
**ARTS, SCIENCE AND COMMERCE COLLEGE, INDAPUR**

(Best College Awardee of S.P.P.U. Pune, 2014)  
Affiliated to Savitribai Phule Pune University, Pune



## INDEX

**Academic Year: -2020-21**

Sr. No	Name of the Author	Name of the Journal	Year of Publication	Page. No
<b>Year 2020-21</b>				
1.	Dr. Kadam G.G	Stradresearch	2021	1.
2.	Dr. Kadam G.G	Studies in Indian place Names	MAR 2020	2.
3.	<b>Dr. Bhosale R.R</b>	Journal of the Maharaja Sayajirao University of Baroda	2021	3.
4.	Dr. Kadam G.G	Scholarly Research Journal For Interdisciplinary Studies (SRJIS)	2020	4.
5.	Dr. Phalphale A. K.	Journal of Research and Development	Feb. 2021	5.
6.	Dr. S K Shinde	International Journal of Biological Macromolecules	45433	6.
7.	Dr. S K Shinde	Ceramics International	44348	7.
8.	Dr. S K Shinde	Journal of Molecular Liquids	May-21	8.
9.	Dr. Phalphale A. K.	Research Journey	Jan. 2020	9.
10.	Dr. S K Shinde	Materials Science & Engineering B	Jun-21	10.
11.	Dr. S K Shinde	Journal of Alloys and Compounds	May-24	11.
12.	Dr. S K Shinde	Journal of Cleaner Production	21-May	12.
13.	Dr. S K Shinde	Chemical Engineering Journal	Apr-21	13.
14.	Dr. S K Shinde	Materials Today Communications	Mar-21	14.
15.	Dr. S K Shinde	Polymers	21-Feb	15.
16.	Dr. S K Shinde	<u>Biosensors and Bioelectronics</u>	21-Apr	16.
17.	Dr. Rajkumar Shelar	Printing Area	Apr-21	17.




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18.	J.B.Bhore	IJREM	Mar-21	18.
19.	Dr. R.V Salunkhe	Journal of the Maharaja Sayajirao University of Baroda	2021	19.
20.	Dr. Surendra Shirsat	Power of the Knowledge	Jul-21	20.

  
**PRINCIPAL**  
**ARTS SCIENCE AND**  
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**Principal**



**A Study of Labour Welfare Initiative at Small and Medium Industries  
(Chatrapati Industry Ltd Loni Devkar, Indapur Dist. Pune Maharashtra)**

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*Abstract*

During the pre-independence period, industrial relations policy of the British Government was one of *laissez fair* and also of selective intervention. There were hardly any labour welfare schemes. After independence, labour legislations have formed the basis for industrial relations and social security. These legislations have also provided machinery for bipartite and tripartite consultations for settlement of disputes. Soon after independence, the Government at a tripartite conference in December 1947 adopted the industrial truce resolution. Several legislations including the following, were enacted to maintain industrial peace and harmony; Factory Act 1948, Employees State Insurance Act, 1948 and Minimum Wages Act, 1948. The Payment of Bonus Act was passed in 1965.

In the early 1990, the process of economic reforms was set in motion when the Government introduced a series of measure to reduce control on industries, particularly large industries. The workers have opposed economic liberalization policy for fear of unemployment while entrepreneurs have welcomed in the hope of new opportunities to improve Indian industrial relations. The new economic policy has directly affected industrial relation in the country, because the Government has to play dual role, one of protecting the interest of the worker's and second to allow a free interplay of the market forces.

Economic reforms by removing barriers to entry have created competitive markets. Fiscal stabilization has resulted in drastic reduction budgetary support to the public sectors commercial enterprises while exposing his enterprises to increased competition from private sector.

**Keyword:** *laissez fair, labour welfare, Minimum Wages, Bonus, Economic reforms*

**Introduction**

Employee welfare is justified for several reasons. A typical worker does a lot of work life digging coal earth, fetching and refining oil, to build dams for society. They look after necessities as well as luxuries of people in society. Thus, welfare measures are must for them.

Welfare measures are going to have a great impact on worker's productivity. Thus, a worker show safeguards economic and social factors of the industrial economy needs a boost with welfare activities.

Welfare may help retain the employee. Most welfare facilities are hygiene factors according to Frederick Herzberg, they create dissatisfaction if not provided. Replace dissatisfaction, place an employee in favorable mood, and provide satisfiers, and the motivation will take place. Welfare facilities, besides removing dissatisfaction, help develop loyalty in workers towards the organization.

Welfare may also help minimize social evils, such as alcoholism gambling, drug addiction etc. a

## Role of Primary Agriculture Cooperative Credit Societies (PACS) in the Development of Agriculture Sector in India

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### Abstract

Primary Agriculture Cooperative Credit Societies (PACS) are the banks which are situated in rural area and plays a very important role in rural credit system by performing their activities on co-operative principles and also these banks are worked under the District Credit Co-operative Banks. They provide short term and medium term loan to rural people to meet their financial requirements. But, the rural people still depend on unorganized sources such as money lenders in village, mandies, traders etc. So, various measures taken by Government to reduce these unorganized sources through the establishment of PACS in rural areas. In order to know the role of PACS in agricultural development in India the study has been undertaken.

**Keywords:** primary, credit, agricultural, co-operative, society, finance.

### Introduction

The co-operative banks in India play a significant job in even today in provincial financing. These are enrolled under the Co-operative Societies Act and furthermore managed by the RBI. They are administered by the "Banking guideline Act-1949" and Banking Laws (Co-operative Societies) Act 1965. The matter of co-operative banks in urban territory additionally have increased in recent year due to sharp increment in the number of essential co-operative banks. The co-operative development was expressed in India generally with the end goal of giving agriculturists reserves for agricultural activities, at low paces of intrigue and shields them from the grip of cash moneylenders.

### Objective of the Study

1. To study the role and performance of PACS in respect of agricultural credit and rural development.
2. To find out reasons for poor recovery of loans in PACS.
3. To offer suggestions to improve the performance of PACS.

### Methodology

The study is based on Secondary data. The data has been collected from books, magazines and websites.

#### A) Role of PACS

A co-operative acknowledges society, ordinarily known as Primary Agricultural Co-operative Society (PACS) might be expressed with at least 10 people, regularly having a place with a town. The estimation of each offer is commonly ostensible in order to empower even most unfortunate rancher to turn into a part. PACS involve a prevalent situation in the co-operative structure and structure its base. A Primary Agricultural Credit Society is sorted out at grass-root level of a town or a gathering of little towns. It is the fundamental unit which manages rustic (horticultural) borrowers, gives those advances and gathers reimbursements of advances given. It fills in as the last connection between definitive

## SOLAR PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE USING Sb-DOPED TiO<sub>2</sub> NANOPARTICLES

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### Abstract:

Sb-doped TiO<sub>2</sub> were synthesized by sol-gel process combined with surfactant incorporating method. The concentration level of Sb (III) additive was varied systematically from 1 to 11 wt.%. Wide structural and surface characterization of samples was carried out in order to establish a correlation between the effects of antimony incorporation on the TiO<sub>2</sub> photocatalytic properties. Results revealed that the anatase structure is highly stable for Sb/TiO<sub>2</sub> with enhancement in the surface area. UV-Vis diffuse reflectance spectra showed that this dopant was responsible for narrowing the band gap of TiO<sub>2</sub> and shifting its optical response from ultraviolet to visible-light region. The photocatalytic activity of the Sb/TiO<sub>2</sub> catalyst was evaluated in the decomposition of methylene blue solution under solar light irradiation with respect to the content of antimony on the catalyst surface. The results showed that the incorporation of antimony into the TiO<sub>2</sub> seems to enhance the photocatalytic activity of the samples, which is ascribed to the enlargement of specific surface area, photo generated carriers separation, light absorption, as well as the higher surface acidity. The photocatalytic efficiency and activity of the composites remained good, even after three cycles.

**Keywords:** Sb/TiO<sub>2</sub>; Nanomaterials; Solar photocatalysis; Methylene blue.

### Introduction:

Photocatalysis has emerged as an effective technique to decontaminate toxic and non-biodegradable environmental pollutants [1-2]. Among various functional metal oxides, TiO<sub>2</sub> is the most nontoxic, highly stable, cost effective, strong oxidant, and noncorrosive semiconductor, which make it more suitable choice for removing organic and inorganic contaminants from the environment [3-4]. The photochemical reactions proceed on a pure TiO<sub>2</sub> surface, when irradiated with ultraviolet light. This barricades the frequent and convenient use of TiO<sub>2</sub> photocatalyst. The increase in redox potential and decrease in the particle size is essential to enhance the photochemical reaction rates. Decreasing the particle size to nano scale, results in the larger surface area per unit mass. Reduction of band gap facilitates the catalyst to make use of solar and visible light energy, which makes it environmentally and electrically suitable photo catalyst [5]. Further, the anatase to rutile phase ratio is also an important factor in enhancing photo catalytic activity. The anatase phase is kinetically more stable and higher hydrophobicity of this phase increases the absorption of reactive species, while rutile phase scatters light which decreases its absorption power [6-7].

Recently, much attention has been paid in modifying TiO<sub>2</sub> to enhance its catalytic efficiency or expand its applicability under solar irradiation [8]. Different metallic [9] and nonmetallic dopants [10] have been doped to decrease the band gap and increase excitation life time of pure TiO<sub>2</sub>. Mao et. al, used nitrogen dopant for the photo-oxidation of organic molecules in water [11]. Shamalah et. al, showed degradation of Brilliant Green dye with Zn and Cu-doped TiO<sub>2</sub> [12]. Moreover, many attempts have been carried out in direction of attaining high surface area photocatalysts to increase active sites by using the support materials like zeolites [13], HZSM-11 zeolite [14], Clinoptilolite [15] and silica-clay composite [16]. Zhang et. al. synthesized mixed platinum catalysts supported on various carbon nanomaterials [17]. The nano Ag/Pt and methyl violet co-doped catalyst was developed resulted in higher photodegradation activities towards various dyes [18]. Elham S. Baeissa investigated the removal of cyanide employing cobalt metal doped on TiO<sub>2</sub>-SiO<sub>2</sub> nanoparticles [19]. Nano sheets of Au/HTiNbO<sub>5</sub> have also been synthesized by Hsin-Yu Lin, et. al to produce hydrogen from water splitting [20]. The important issue governing the efficiency of photocatalytic oxidative degradation is minimizing electron-hole recombination by maximizing the rate of interfacial electron transfer to capture the photogenerated electron and/or hole. Various n and p type photocatalysts are well documented in the literature. A Na-doped p-type flower-like ZnO photocatalyst (Na:ZnO) that is highly visible-light-sensitive in air at room temperature was synthesized by a continuous flow microreactor [21]. Rh-doped BaTiO<sub>3</sub> powder was prepared by the polymerized complex (PC) method, and the photocatalytic activity for H<sub>2</sub> evolution from water was examined. BaTiO<sub>3</sub> is a wide-gap n-type semiconductor having a band gap of 3.0 eV. Doping Rh species into the lattice of BaTiO<sub>3</sub> resulted in the formation of new absorption bands in visible light region [22]. Different p-type Cu<sub>2</sub>O powders were prepared from electro deposition and subjected to analysis of their photocatalytic activity in water reduction [23]. Sb-doped catalyst on different supports has been synthesized previously [24-25]. However, they did not evaluate the effect of concentration level of Sb (III) on crystallite size, specific surface area and phase transformation and surface



# AN OVERVIEW OF INDIAN AGRICULTURE SECTOR IN THE ERA OF GLOBALIZATION

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## Abstract

The term globalization refers to International Integration. It includes opening up of world trade, development of advanced means of communication, internalization of financial markets, growing importance of MNC's, population migration and more generally increased mobility of persons, goods, services, capital, data and ideas. It is a process through which the diverse world is unified into a single society. In short it is a creation of world into a global village. It is the recent concept that has come to govern the world since end of the 20<sup>th</sup> century with the end of the cold war and melting down of Soviet Union. The need of structural changes in various world economies, dominance of market related economies, growing importance of private resources and capital and pressure of world bank and other International organizations like IMF (International Monetary Fund) have started this process in many of the developing countries like India. It has brought in new opportunities to developing countries. Greater access to foreign markets, technology transfer, improved productivity and higher living standard are some of the advantages of this process to the countries like India. But it has also creates new challenges like growing inequality across and within nations, volatility in financial market and environmental deterioration.

tions. As Indian is agrarian economy it is wise to know the impact of Globalization on Indian economy. An overview of Indian agricultural sector indicates that globalization did not yield the desired results in India. It has marginally contributing in minimizing poverty, and removing social inequalities. The desired objectives of this process have not been achieved in India. As far agricultural sector is concerned we have seen mixed results in the country. It is clear with the study that agriculture plays key role in the economy. Agriculture employees 59% of Indian population, yet it contribution varies only from 15 to 20% of the GDP (Gross Domestic Product). After adoption of globalization in 1991 Indian agriculture growth rate increase but at present the economy condition of the farmers is not satisfactory because input cost is high and output cost is low. Cut off of subsidies are hindering growth of agricultural sector

**Keywords:** Globalization, International integration, agriculture, social inequality, subsidy, International Monetary Fund, Gross Domestic Product.

## Introduction:

The term globalization refers to International Integration. It includes opening up of world trade, development of advanced means of communication, internalization of financial markets, growing importance of MNC's, population migration

## **Finding Locations for Continuous Contour Trenches in Indapur Tahsil, Dist. Pune (Maharashtra)**

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### **Introduction**

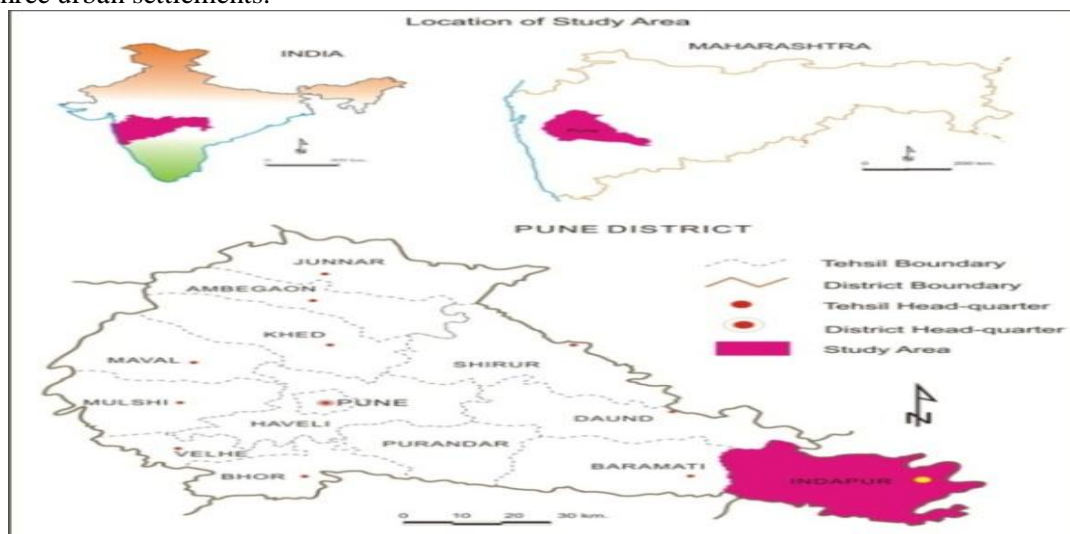
Water is vital to life, without which no living body can survive. Water is considered as prime natural resource, a basic human need and a valuable national asset. Water is core component of environment. Now days, there are many problems rises related to water quantity and quality. Water scarcity is also main problem because of over use of surface and ground water. So watershed management is the need not only for water conservation and soil conservation, but also has impact on food production and national economy. Continuous Contour Trenches (CCT) method is helpful to increase ground water level in the surrounding areas/ dug wells and tube wells which increases the yield of farms and water quality. This will also avoid loss of soil due to erosion; increase the grass coverage which will helpful for soil stabilization. This method can be adopted in low rainfall area to high rainfall area up to 3200mm and from flat area to hilly area with 65% steep slope. This method is suitable for plantation of all species and easy, simple for laborers and comparatively less record keeping. Indapur tahsil is one of the tahsils of rain shadow tahsil in Maharashtra. Average annual rainfall of Indapur tahsil is about 450 mm.

### **Origin of the research problem:**

Indapur tahsil is selected for the study of water resources. The choice and topic under investigation is influenced by many considerations. Firstly, researcher belongs to Indapur tahsil hence is familiar with the study region. Secondly, study region falls in drought prone region of Deccan trap of Maharashtra state receiving annual average rainfall between 400-500 mm. It is distributed unevenly in study region. Thirdly, irrigation is dominant factor in study region having considerable impact on water use in Indapur tahsil. Although main sources of water for study region is the rivers like Bhima, Nira and other tributaries, there is drought in some region of Indapur tahsil. Fourthly, this region has not been so far studied in depth for water analysis point of view by geographers. The main problem is that water source is abundant in the part of east and south of Indapur tahsil, whereas water sources is scanty in west and north side of Indapur tahsil. So we study the water resources in Indapur tahsil.

### **Location, Situation and Site**

Indapur tahsil is situated in Pune district. The northern and eastern border is demarcated by Bhima river in Pune and Solapur districts while southern boundary is confined by Nira River in Pune and Satara and Solapur districts. The west boundary is confined by Baramati and north boundary is delimited by Daund tahsil of Pune district. The region extends between 17° 53' to 18° 15' north latitudes and 74° 35' to 75° 8' east longitudes. The total geographical area of this tahsil is 1552.93 square kilometres having 3, 83,183 population (2011). This tahsil consists of 142 settlements and three urban settlements.



### **Objectives :**

1. To study the slope analysis and soil distribution of study area.



# Physicochemical characterization, drug release, and biocompatibility evaluation of carboxymethyl cellulose-based hydrogels reinforced with sepiolite nanoclay

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## ABSTRACT

Polymer–clay nanocomposite hydrogel films (PCNCHFs) were prepared from carboxymethyl cellulose, polyvinylpyrrolidone, agar and nanosepiolite clay (0, 0.3, 0.5, 0.7, 0.9 and 1.5% reinforcement) by treating thermally in a simple, rapid, and inexpensive route. The PCNCHFs and its 5-fluorouracil (FU)-loaded composites (PCNCHFs@FU) were tested for FU release and characterized by FTIR, XRD, FE-SEM, EDX, DSC, and TGA analyses to investigate their structural, morphological, and thermal properties. The nanosepiolite-loaded polymer composites (PCNCHF1 to PCNCHF5) exhibited higher tensile strength than the pristine polymer hydrogel (PCNCHF0); consequently, the thermal properties (glass- and melting-transition) were improved. The PCNCHFs@FU demonstrated prolonged FU release at pH 7.4 for 32 h. The biocompatibility of PCNCHFs was tested against human skin fibroblast (CCDK) cells. The viability of cells exposed to all PCNCHFs was >95% after 72 h of culture. The live/dead assay shows the proliferation of fibroblast cells, confirming the biocompatibility of the hydrogels. The pH-sensitive PCNCHFs@FU release could be suitable for drug release in cancer therapy, and the developed PCNCHFs may also be useful for tissue engineering, food packaging, and other biological applications.

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## 1. Introduction

Biopolymer-based composite hydrogels are in great demand for various applications, including those encompassing the pharmaceutical, environmental, and biomedical fields, due to their economic, environment-friendly, biodegradable, and biocompatible nature [1–3]. In brief, three-dimensional hydrophilic polymeric networks with high water affinity usually do the construction of polymer-based hydrogels. Instead of dissolving into solution, their physically and/or chemically cross-linked structures allow them to hold water [4–6]. Hydrogels can be constituted with different macromolecules with various functional groups, such as -OH, -SO<sub>3</sub>H, -COOH, -CONH-, and -CONH<sub>2</sub>, in their polymeric backbone (either embedded in or grafted to). Because of their hydrophilic functional domains, the resulting hydrogels can absorb and retain large amount of water and other biological fluids/cells. Therefore, these swollen three-dimensional viscoelastic polymer network structures can

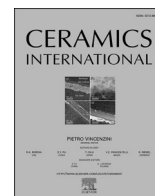
resemble natural tissue and is of great importance in biomedical field [7–9]. Carboxymethyl cellulose (CMC) based hydrogel systems were developed by different methods, such as physical blending, chemical grafting, and ionic gelation etc. However, the polyelectrolyte behavior of CMC is due to the presence of carboxylate moiety, which is a pH sensitive group with in-situ gelation ability, resulting in bio-adhesive behavior. Hence, the electrically controlled CMC based systems are very useful in delivering various pharmaceuticals such as 5-fluorouracil (FU) for colon drug release, wound dressing, and tissue engineering, because of its biocompatibility [10–16].

Recently, the European Food Safety Authority reported that, CMC is a safe food additive for all animals; moreover, it was also shown to be harmless to the environment because of its biodegradation propensity [17]. The unique viscosity characteristics, hydrophilic nature, adhesive behavior, film forming ability, and biocompatibility, the CMC-based hydrogels have wide range of industrial applications [18–21], in addition to biomedical [22–24] and environmental applications [25–27]. The pristine polymer hydrogels show lower mechanical stability without chemical crosslinking agents. Therefore, it is necessary to use ecofriendly materials as alternative for reinforcement strategy. To

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# Novel and efficient hybrid supercapacitor of chemically synthesized quaternary 3D nanoflower-like NiCuCo<sub>2</sub>S<sub>4</sub> electrode

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## ABSTRACT

In this work, we employed a simple and cost-effective chemical route to obtain a highly stable and efficient quaternary mesoporous 3D nanoflower-like NiCuCo<sub>2</sub>S<sub>4</sub> nanocomposite for supercapacitor applications. The NiCuCo<sub>2</sub>S<sub>4</sub> composite exhibited a mixture of NiCo<sub>2</sub>S<sub>4</sub> and CuCo<sub>2</sub>S<sub>4</sub> phases, confirming the formation of a quaternary NiCuCo<sub>2</sub>S<sub>4</sub> thin film. A surface morphological analysis revealed the unique nanoflower-like nanostructure of the annealed composite. The electrochemical analysis of the NiCuCo<sub>2</sub>S<sub>4</sub> electrode demonstrated a high specific capacity (Cs) of 414 mAh g<sup>-1</sup> at a lower scan rate of 10 mV s<sup>-1</sup> and a superior cycling stability up to 3000 cycles. A solid-state hybrid supercapacitor (SHS) was also constructed by the NiCuCo<sub>2</sub>S<sub>4</sub> and AC powder as positive and negative electrodes, respectively. The NiCuCo<sub>2</sub>S<sub>4</sub>/AC hybrid cell produced a high Cs, energy density, and power density of 159 F g<sup>-1</sup>, 35.19 Wh kg<sup>-1</sup>, and 0.66 kW kg<sup>-1</sup>, respectively at a current density of 10 mA with good cycling stability. The results demonstrated that the fabrication process is effective for the development of a novel quaternary transition metal sulfide (TMS) electrode.

## 1. Introduction

The expansion of a high-energy storage system has fascinated significant consideration due to the rising demand for efficient renewable energy sources. The capable energy storage systems such as supercapacitors (Sc) offer a high power density, energy density, cycling stability, lower resistance, and greater safety compared to batteries [1,2]. Electrochemical supercapacitors store energy either through ion adsorption (electrochemical double-layer capacitors, EDLCs) or fast, reversible, multi-electron surface redox reactions (pseudocapacitors). Highly reversible redox reactions are responsible for the high specific capacitance of pseudocapacitor devices [3–5]. Physicochemical properties of the selected materials strongly affect the performance of supercapacitor devices. For instance, the electrochemical performance can degrade during the cycling due to change in the morphology of selected materials. Therefore, it is important to improve the morphological stability of supercapacitive electrode materials to maximize their cycle life [6]. Materials with hierarchical pores and tabular or layered

structures are well-known to increase the charge transport, ion diffusion, power density, and the cycling stability [1,7]. In addition to structural design, the electrode composition also have a crucial role in the performance of electroactive materials [8]. The electrochemical performance can be tuned by optimizing the ratio of metal ions.

Several nanomaterials with desirable properties fabricated from carbonaceous materials and metal oxides have been employed in supercapacitor applications. In particular, metal chalcogenides exhibit excellent physicochemical properties that are suitable for supercapacitor applications. Ni, Co, and Cu-based materials have attracted significant attention in various fields, the oxides and sulfides of these metals have been proven to be useful for electrochemical energy storage applications [9]. These metals are an important strategic resources which are mostly suitable in electrochemical energy storage systems, catalysis, and other fields due to their unusual structural, optical, and electronic properties [10]. Ni, Co, and Cu-based battery materials in aqueous and alkaline electrolytes have been reported to facilitate fast Faradaic reactions on or near their surface, thus offering both high energy storage and power

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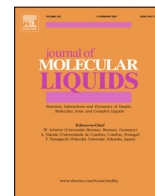
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# Green synthesis of novel $\text{CuCo}_2\text{O}_4$ nanocomposite for stable hybrid supercapacitors by deep eutectic solvents

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Hybrid supercapacitor

## ABSTRACT

Currently, many transition metal oxides (TMOs) have been demonstrated as attractive nanomaterials for application in supercapacitors for energy storage/conversion systems. Among TMOs,  $\text{CuCo}_2\text{O}_4$  has presented excellent electrochemical properties, including higher electrical behavior. Also, they are readily accessible in earth, ecofriendly and cost effective compared to other nanocompounds. In this research, we have for the first time synthesized  $\text{CuCo}_2\text{O}_4$  (CCO) nanomaterials using a deep eutectic solvents (DES) method for supercapacitor (SC) applications. We systematically studied the effect of annealing temperature of CCO on its structural, morphological, and electrical properties. The CCO was annealed at different temperature of 150, 200, 250, and 300 °C for 3 h. CCO annealed at 250 °C exhibited the superior performance compared to other as-synthesized and annealed samples. The optimized CCO electrode shows outstanding supercapacitive properties with specific capacity 421  $\text{mAh g}^{-1}$  at 10  $\text{mV s}^{-1}$ , excellent GCD capability, and super cycling stability. This indicates that the DES-prepared CCO shows better electrochemical performance due to highly porous nanostructure providing more active sites for easy trans-formation of the ions.

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## 1. Introduction

Supercapacitors (SCs) are the core component in the development of sustainable energy storage systems with high power density, high energy density, fast charge–discharge, long life, cycling stability, and low cost [1–4]. SCs can be classified into two categories based on the charge storage mechanism: electrical double layer capacitors (EDLCs), which consist of electrostatic charge accumulation at the electrode/electrolyte interfaces, and pseudocapacitors, which comprise reversible Faradic reactions. Pseudocapacitors deliver much higher specific capacitance and energy density than the EDLC [5–7]. Metal oxides of copper, nickel, cobalt, and manganese have gained increasing attention in SCs research because of their electrochemical properties [8,9]. Copper oxide and cobalt oxide has many potential applications in various scientific technologies. Among numerous metal oxides, binary transition metal oxides (TMOs) of copper and cobalt showed excellent elec-

trochemical properties, such as specific capacitance, conductivity, cycling performance, and structural stability [10].

The earth abundant spinel type cobalt oxide and its derived compounds offer a promising alternative cheap material for electrochemical energy storage application because of its high theoretical capacitance  $\sim 3600 \text{ F g}^{-1}$ , electrochemical reversibility, and stability. However, the electrochemical performance was slightly lower than expected due to the internal low conductivity, morphology, surface area, chemical composition, and crystallinity [11,12]. Recently, many efforts have been devoted to overcoming these obstacles by designing mixed-metal oxides, controlling morphology, size, and structural properties. Previous reports found that the introduction of Cu in the host cobalt oxide could be beneficial towards improving conductivity and electrochemical properties. Therefore, copper cobalt-based oxides have been highlighted because of their natural abundance, excellent stability, and low cost. Furthermore, amalgamation of metal oxides is a promising way to boost electrical conductivity, electro-chemical properties, and structural stability.

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## Study and Analysis of Water Resources in Indapur Taluka ( Pune District )

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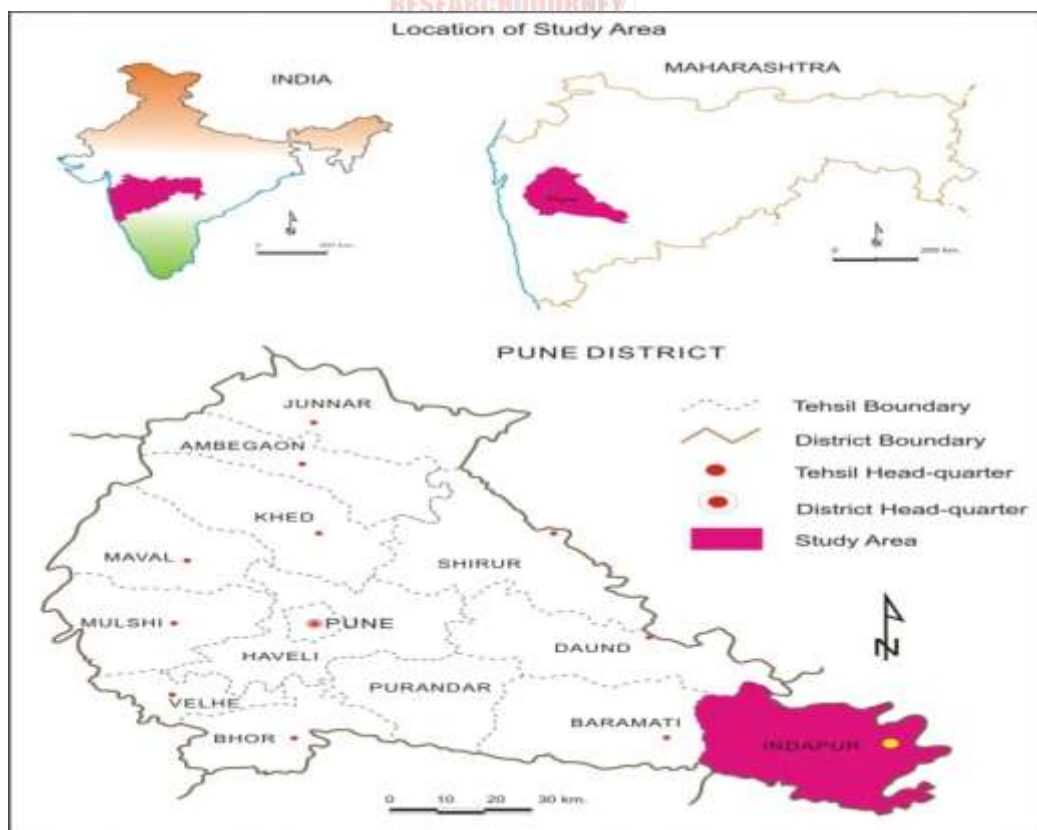
### 1. Introduction

Water is vital to life, without which no living body can survive. Water is considered as prime natural resource, a basic human need and a valuable national asset. Water is core component of environment. There is vast disparity in the distribution and utilization of water resource at the global, regional and local levels. Water scarcity due to depletion of surface as well as ground water following fast population growth, urbanization, rising incomes, industrial development etc. For water management, we need to assess the water resources.

The main problem is that water source is abundant in the part of east and south of Indapur taluka, whereas water sources is scanty in west and north side of Indapur taluka. So we have studied the water resources in Indapur taluka.

### 2. Study Area

Indapur tahsil is situated in Pune district. The northern and eastern border is demarcated by Bhima river in Pune and Solapur districts while southern boundary is confined by Nira River in Pune and Satara and Solapur districts. The west boundary is confined by Baramati and north boundary is delimited by Daund tahsil of Pune district. The region extends between  $17^{\circ} 53'$  to  $18^{\circ} 15'$  north latitudes and  $74^{\circ} 35'$  to  $75^{\circ} 8'$  east longitudes. The total geographical area of this tahsil is 1552.93 square kilometres having 3, 83,183 population (2011). This tahsil consists of 142 settlements and three urban settlements.





# Probing the electrochemical properties of $\text{NiMn}_2\text{O}_4$ nanoparticles as prominent electrode materials for supercapacitor applications

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## ABSTRACT

$\text{NiMn}_2\text{O}_4$  (NMO) powders have been prepared by facile sol-gel route, and the effect of annealing temperature and the concentration of KOH electrolyte on its electrochemical performance has been investigated. The electrochemical performance of the NMO electrodes is tested via a three electrode arrangement in KOH electrolyte. The NMO electrode (NMO1) prepared from the powder synthesized at a temperature of 500 °C with an approximate crystallite size of 10 nm exhibits maximum specific capacitance of 571  $\text{Fg}^{-1}$  at a scan rate of 5  $\text{mVs}^{-1}$  in 1 M KOH electrolyte. The specific capacitance of the NMO1 electrode is found to be improved from 571  $\text{Fg}^{-1}$  in 1 M KOH to 762  $\text{Fg}^{-1}$  in 6 M KOH electrolyte. The improvement in the specific capacitance of the NMO1 working electrode in 6 M KOH electrolyte can be attributed to good electrochemical utilization and an effective charge storage mechanism.

## 1. Introduction

Supercapacitors (SCs) have attracted much attention because of the fast rechargeability, higher power density over the batteries, and more energy storage ability as compared to conventional capacitors. The SCs have enormous energy storage capacity besides possessing the combined property of both conventional capacitor and battery [1]. Based on the charge-storage mechanism, electrochemical SCs can be classified into three categories: viz, pseudocapacitors, electrical double-layer capacitors (EDLCs), and hybrid capacitors. The conducting polymers and various metal oxides are utilized as the active electrode materials in pseudocapacitors, whereas in EDLCs carbon-based materials such as activated carbon, graphene, and carbon nanotubes are used as active electrodes. One more type of SCs is a mixture of both pseudocapacitors and EDLCs, known as a hybrid capacitor. To construct these types of SCs, the active electrode materials are made by combining either two or three distinct elements which give very large specific capacitance and

enhanced energy density than pseudocapacitors or EDLCs [2]. However, all the above-mentioned SCs still suffer from some significant disadvantages such as poor cyclic life span of conductive polymers, the low capacitance of carbon-based materials and high cost of typical transition metal oxides like  $\text{RuO}_2$  [3].  $\text{RuO}_2$  has been extensively investigated as a promising material due to its high specific capacitance and excellent cycling stability, but rareness and the high cost of ruthenium element are putting significant barriers to its commercialization [4]. To overcome these significant disadvantages, it is necessary to explore other alternative materials for the fabrication of supercapacitors.

Mixed transition metal oxides (MTMOs) are preferred to fabricate electrode materials for supercapacitor application over the single transition metal oxide component due to its enhanced chemical stability and electrochemical properties [5]. Out of the different MTMOs, considerable attention has been centered towards the synthesis of cubic spinel  $\text{NiMn}_2\text{O}_4$  (NMO) as it offers high conductivity, outstanding electrochemical capacitance, high redox-active sites, and exceptional chemical

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# Hierarchical nanosheets of ternary CoNiFe layered double hydroxide for supercapacitors and oxygen evolution reaction

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## ABSTRACT

The preparation of stable and efficient thin films with excellent energy storage and conversion capabilities has attracted great attention in the field of supercapacitors and electrocatalysis. Herein, hierarchical nanosheets-based ternary CoNiFe layered double hydroxide (LDH) thin films are prepared via an inexpensive and facile electrodeposition method. The structural, morphological, and electrochemical properties of films are systematically studied and compared with their binary counterparts. As prepared CoNiFe LDH shows a maximum specific capacity of 360 C g<sup>-1</sup> at the current density of 0.4 A g<sup>-1</sup> with a capacity retention of 51% even at the higher current density of 10 A g<sup>-1</sup>. Moreover, it shows excellent cyclic stability of 84% after 2000 cycles. As an electrocatalyst, CoNiFe LDH demonstrates an excellent performance in OER, affording an overpotential of 196 mV at the current density of 10 mA cm<sup>-2</sup> with a Tafel slope value of 49 mV dec<sup>-1</sup>. Also, it depicts excellent catalytic stability with stable operation for over 10 h. Thus, ternary CoNiFe LDH thin film can be used as a promising electrode material for both electrochemical energy storage and catalysis.

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## 1. Introduction

The continuously increasing energy consumption and concerns over environmental pollution require significant global efforts on efficient generation, storage, and transmission of energy [1]. The electrochemical energy storage and electrocatalysis have been considered to be the most effective technologies to remove the aforementioned stumbling block [2]. Among electrochemical energy storage devices, such as batteries and supercapacitors (SCs), SCs have attracted great importance owing to their high specific capacitance, long cycle life, and high power density [3]. The SC bridges the gap between conventional capacitors and rechargeable batteries by combining advantages of both. However, SCs are characterized by their poor energy density. Therefore, a variety of different materials has been investigated to improve the energy density of SCs [4]. SCs are categorized into electric double layer capacitors (EDLCs) and pseudocapacitors. Compared with EDLCs, pseudocapacitors demonstrate superior capacitive performance owing to the involvement of

fast redox reactions and tremendous scales of electrostatic charge diffusion and accumulation [5]. Electrode materials such as transition metal oxides, hydroxides, sulfides, carbides, nitrides, conducting polymers, etc. neither exhibit pure pseudocapacitive nor faradaic behavior. These materials can be classified as battery-like electrodes which have attracted great attention in recent years [6].

On the other hand, the electrochemical water splitting using high-performance electrocatalysts is imperative to produce oxygen and hydrogen for fuel cell and metal-air battery technologies [7]. During water splitting, the hydrogen evolution reaction (HER) is a straightforward process that readily happens at low overpotential. However, the oxygen evolution reaction (OER) ( $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ ) is an arduous process owing to the sluggish four-electron transfer steps [2]. Previously, transition metal oxides such as RuO<sub>2</sub> and IrO<sub>2</sub> have been reported as high-performance electrocatalysts for OER [8]. However, it is important to explore highly competent and inexpensive OER catalysts based on earth-abundant elements.

Recently, transition metal-based layered double hydroxides (LDHs) have attracted great attention in the field of SCs, electrocatalysts, and electrochemical sensors because of their highly reversible redox kinetics, cost-effectiveness and excellent structural and compositional tunability [9–11]. The general formula for LDHs is

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## Review

# Review on biomass feedstocks, pyrolysis mechanism and physicochemical properties of biochar: State-of-the-art framework to speed up vision of circular bioeconomy



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## ABSTRACT

The biochar is a solid carbon-rich, porous material produced by the thermochemical conversion of a diverse range of biomass feedstocks under an inert atmosphere (i.e., in the absence of oxygen). We can produce the biochar at all likely scales, ranging from the industrial to the domestic level and even at individual farms, thus, the biochar industry is leading as a most appropriate at different socioeconomic settings. The possibility of sustainable biochar production practices and multi-functionality features make it a promising candidate to fulfill an increasing demand in the fields of soil amendment, agricultural sustainability, environmental protection, cutting-edge materials, and to achieve circular bioeconomy and mitigation of climate change. An available fraction of waste biomass (agroforestry waste, biomass crops, agricultural residues, mill residues, and animal manure, and many more) can be used efficiently in pyrolysis and converted into desired biochar materials, besides this alternative energy products, such as syngas, bio-oil, electricity generation, and process heat. This report emphasizes the fate of biomass composition, pyrolysis mechanisms, and applications of modern analytical and characterization techniques that are being adopted, applied, and standardized to improve understandings of molecular, structural, and surface properties characteristics of biochar. To achieve precisely designed biochar, there is a need to understand the latest advances in biochar materialization mechanisms and structure-application relationships to speed up their agronomic applications and to achieve a zero-waste dream. This report also summarizes a wide range of literature published on feedstocks, pyrolysis, and biochar and suggests several practical recommendations appropriate to implement and bring together specific details on the thermochemical conversion of biomass, desired biochar properties, organic and inorganic phases, and the significance to the agronomic applications.

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## Contents

1. Introduction .....	2
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# Electrochemical synthesis of binder-free interconnected nanosheets of Mn-doped Co<sub>3</sub>O<sub>4</sub> on Ni foam for high-performance electrochemical energy storage application

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## ARTICLE INFO

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Mn-doped Co<sub>3</sub>O<sub>4</sub>  
Potentiodynamic deposition  
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Electrochemical energy storage

## ABSTRACT

In this study, various nanostructures of Mn-doped Co<sub>3</sub>O<sub>4</sub> were synthesized on Ni foam using binder-free electrochemical technology for electrochemical energy storage applications. Using the cyclic voltammetry method with different scan rates, diverse nanostructures, i.e., irregularly oriented nanooctahedra, interconnected standing nanosheets, and nanopetals of Mn-doped Co<sub>3</sub>O<sub>4</sub>, were obtained. The standing interconnected nanosheets on the Ni foam exhibited remarkable supercapacitive performance due to the void space between the sheets and mesoporous structure, which provided additional active sites for faradic transitions. The nanosheets exhibited excellent electrochemical performance with a maximum specific capacitance of 1005F g<sup>-1</sup> and a cyclic stability of 88% during 5000 charge–discharge cycles. Moreover, an asymmetric supercapacitor was assembled comprising activated carbon on Ni foam and interconnected nanosheets of Mn-doped Co<sub>3</sub>O<sub>4</sub> on Ni foam as negative and positive electrodes, respectively. This assembled device exhibited an improved potential of 1.6 V, a maximum specific energy of 20.6 Wh kg<sup>-1</sup>, and a maximum specific power of 16 kW kg<sup>-1</sup> with 80.6% capacity retention after 2000 charge–discharge cycles, which is superior for SC devices.

## 1. Introduction

Effective electric energy storage and retrieval are important aspects for the development of sustainable and renewable energy devices. Most of the research on this topic has focused on the use of nontoxic, abundantly available materials for low production cost and enhanced operational safety [1]. In particular, Li-ion battery technology stands out for its ability to deliver high specific energy in various electrical appliances, including medical devices and communication implements [2,3]. However, for the development of next-generation hybrid devices, supercapacitors (SCs) with high specific power that can provide large amounts of electrical energy in short periods are required. Basic electrochemical reactions occurring at the electrodes of SCs play a vital role in SC operation. In this context, SCs can be divided into two types: electrical double-layer capacitors (EDLC) with nonfaradic charge storage and pseudocapacitors with faradic charge storage. In general, SCs

based on carbon nanomaterials such as carbon nanotubes, graphene oxides, and activated carbon (AC) are EDLCs, which exhibit high electrical conductivity and large surface areas. In contrast, transition metal oxides (TMOs), including MnO<sub>2</sub>, Mn<sub>2</sub>O<sub>3</sub>, RuO<sub>2</sub>, Co<sub>3</sub>O<sub>4</sub>, Fe<sub>2</sub>O<sub>3</sub>, and TiO<sub>2</sub>, which undergo reversible faradic reactions, are used as pseudocapacitive materials [1,4]. These TMOs can deliver much higher energy density than carbon-based materials [1,2]. In particular, thin-film nanostructures of Co<sub>3</sub>O<sub>4</sub> are considered to be good pseudocapacitive materials offering broad redox peaks over wider potential ranges compared with the sharp redox peaks of battery electrode materials [5,6].

Unfortunately, the low conductivity of TMO materials is a limitation for SC applications, and extensive research efforts have been devoted to enhance their performance. Studies have shown that TMOs having more than one cation exhibit better performance than oxides with single cations [7–9] and that the properties of core TMOs can be altered by

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# A review on electrodeposited layered double hydroxides for energy and environmental applications

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## ABSTRACT

The great demand for efficient and low-cost materials for energy and environmental applications has been inspiring researchers to develop novel and advanced materials. Recently, layered double hydroxides (LDHs) are found to be admirable materials for various applications owing to their tunable elemental composition and diverse nanostructures. The preparation of binder-free LDHs thin-film electrodes has attracted great attention in the field of supercapacitors, electrocatalysts and sensors. The electrodeposition method exhibits the capability of fabricating binder-free, uniform and well-oriented thin films with tunable elemental composition. In the present review, we provide a detailed electrodeposition mechanism behind the formation of LDHs with nucleation and growth processes. Also, we summarize the literature on electrodeposited LDHs based electrode materials for energy and environmental applications. In energy storage applications, a loading amount of active materials on the substrate is crucial to improve the areal and volumetric capacities. Therefore, the utilization of low-cost and scalable scaffold materials such as carbon nanofibers, graphene foam, etc. is highly recommended.

## 1. Introduction

Layered double hydroxides (LDHs), often called hydrotalcite-like systems or anionic clays have attracted great attention owing to their tunable chemical and metal-anion compositions. The general formula for LDHs can be written as  $[M^{II}_{1-x}M^{III}_x(OH)_2]^{x+}[A^{n-}_{x/n}yH_2O]^{x-}$  (where  $M^{II}$  and  $M^{III}$  represent the divalent and trivalent metal cations,  $A^{n-}$  represents n-valent anions). Depending upon the nature of cations and  $M^{II}/M^{III}$  molar ratios, LDHs can be prepared with a wide range of layered structures [1]. The tunability of the molar ratio of metal cations and the nature of interlayer compensating anions lead to the formation of different nanoarchitectures with versatile physical and chemical properties, extending their applicability in diverse fields [2]. LDHs have been reported for different energy and environmental applications such as electrochemical energy storage, electrocatalyst, sensors, etc. These applications demand well-oriented, uniform and high conducting thin films [3,4]. Previously, LDHs have been prepared by different chemical methods such as co-precipitation [5], hydrothermal [6], sol-gel [7] and urea hydrolysis [8], either in thin film or powder form. These chemical methods are time-consuming and complex. Also, the powdered materials need to be combined with binders and conducting additives to be

applied for many energy and environment-related applications, imposing additional inactive mass to the electrode [9]. In order to overcome these disadvantages, a binder-free LDHs can be prepared using electrodeposition method. The electrodeposition is rapid, facile, and scalable method which deposits well oriented and high quality thin film materials on the conducting support with enhanced conductivity and electrochemically active sites [10]. Recently, variety of different LDHs thin films have been prepared using electrodeposition method. Fig. 1 shows the number of publications and number of citations received by the research papers published in the field of electrodeposited LDHs, indicating the influence of the field.

Recently, some review articles have been published in the field of LDHs [1,11–13]. However, they mainly focus on general synthesis methods and their different applications. To the best of our knowledge, there is no review article published that emphasizes the detailed electrodeposition mechanism behind the formation of LDHs and review of electrodeposited LDHs for energy and environmental applications. It is important to understand the detailed electrodeposition mechanism in preparing LDHs for a variety of applications to fabricate efficient materials by overcoming present difficulties. Therefore, in this review, we have discussed the fundamentals of electrodeposition methods with

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## Article

# $\alpha$ -Cellulose Fibers of Paper-Waste Origin Surface-Modified with $\text{Fe}_3\text{O}_4$ and Thiolated-Chitosan for Efficacious Immobilization of Laccase

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**Abstract:** The utilization of waste-paper-biomass for extraction of important  $\alpha$ -cellulose biopolymer, and modification of extracted  $\alpha$ -cellulose for application in enzyme immobilization can be extremely vital for green circular bio-economy. Thus, in this study,  $\alpha$ -cellulose fibers were super-magnetized ( $\text{Fe}_3\text{O}_4$ ), grafted with chitosan (CTNs), and thiol (-SH) modified for laccase immobilization. The developed material was characterized by high-resolution transmission electron microscopy (HR-TEM), HR-TEM energy dispersive X-ray spectroscopy (HR-TEM-EDS), X-ray diffraction (XRD), vibrating sample magnetometer (VSM), X-ray photoelectron spectroscopy (XPS), and Fourier transform infrared spectroscopy (FT-IR) analyses. Laccase immobilized on  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs ( $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase) gave significant activity recovery (99.16%) and laccase loading potential (169.36 mg/g). The  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase displayed excellent stabilities for temperature, pH, and storage time. The  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase applied in repeated cycles shown remarkable consistency of activity retention for 10 cycles. After the 10th cycle,  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs possessed 80.65% relative activity. Furthermore,  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase shown excellent degradation of pharmaceutical contaminant sulfamethoxazole (SMX). The SMX degradation by  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase was found optimum at incubation time (20 h), pH (3), temperatures (30 °C), and shaking conditions (200 rpm). Finally,  $\alpha$ -Cellulose- $\text{Fe}_3\text{O}_4$ -CTNs-Laccase gave repeated degradation of SMX. Thus, this study presents a novel, waste-derived, highly capable, and super-magnetic nanocomposite for enzyme immobilization applications.

**Keywords:**  $\alpha$ -Cellulose; waste-paper-biomass; chitosan; laccase immobilization; super-magnetic

## 1. Introduction

Paper and cardboards related waste count near about 30% of the total urban solid waste produced worldwide [1]. Despite recycling rates is higher in most of the developed countries, solid paper waste [2], and food waste [3,4], remained as a significant concern to the landfill sites. At the same time, the growing population worldwide, and the emergence of linear bio economies in addition to the growing demand for end-use products causing over-exploitation of natural resources at a rapid pace [5,6]. On average about 55% of the slurry from the paper industry globally are made from the secondary fibers called



# Biological characteristics and biomarkers of novel SARS-CoV-2 facilitated rapid development and implementation of diagnostic tools and surveillance measures

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## ABSTRACT

Existing coronavirus named as a severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has speeded its spread across the globe immediately after emergence in China, Wuhan region, at the end of the year 2019. Different techniques, including genome sequencing, structural feature classification by electron microscopy, and chest imaging using computed tomography, are primarily used to diagnose and screen SARS-CoV-2 suspected individuals. Determination of the viral structure, surface proteins, and genome sequence has provided a design blueprint for the diagnostic investigations of novel SARS-CoV-2 virus and rapidly emerging diagnostic technologies, vaccine trials, and cell-entry-inhibiting drugs. Here, we describe recent understandings on the spike glycoprotein (S protein), receptor-binding domain (RBD), and angiotensin-converting enzyme 2 (ACE2) and their receptor complex. This report also aims to review recently established diagnostic technologies and developments in surveillance measures for SARS-CoV-2 as well as the characteristics and performance of emerging techniques. Smartphone apps for contact tracing can help nations to conduct surveillance measures before a vaccine and effective medicines become available. We also describe promising point-of-care (POC) diagnostic technologies that are under consideration by researchers for advancement beyond the proof-of-concept stage. Developing novel diagnostic techniques needs to be facilitated to establish automatic systems, without any personal involvement or arrangement to curb an existing SARS-CoV-2 epidemic crisis, and could also be appropriate for avoiding the emergence of a future epidemic crisis.

## 1. Introduction

A severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first appeared in the China Hubei Province, Wuhan at the end of December 2019. Considerable number of sick patients with severe and moderate symptoms including fever, shortness of breath, and coughing were rushed for admission to the nearby hospitals. These patients were underwent computed tomography (CT) scans and the results revealed opacities in their lungs (profuse, dense, and confluent types), which were differed from that of the CT scan images of the healthy human lungs (Ai et al., 2020; Zhou et al., 2020c). Ahead of the development,

existing nucleic acid-based diagnostic kits, CT scans, and symptoms were collectively used in the initial diagnosis of SARS-CoV-2 infections. Later, well-established nucleic acid-based test kits were made available for most of the known viral panels and performed with a straight multiplex approach using a well-known technique called real-time polymerase chain reaction (RT-PCR), but, the results were found to be negative, indicated that the contagion of the infection was novel and thus, the origin of virus was unknown (Park et al., 2020; Zhang et al., 2020d). In the first week of January 2020, bronchoalveolar lavage (BAL) fluid samples of different patients were examined and mysterious virus with great similarity to the viral genome of the betacoronavirus-B family

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कन्हैयालाल धबधबा, मत्स्या धबधबा आणि जांभळी  
धबधबा व अनेक कमळांच्या तलावांमुळे पावसाळ्यात  
थक्क करणारे सौंदर्य अनुभवते.

27

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## २००० नंतरच्या भटक्या विमुक्त जमातींच्या आत्मकथनांचे बदलते स्वरूप

श्री. राजकुमार बबन शेलार  
ता. इंदापूर, जि. पुणे

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प्रस्तावना :

भटक्या विमुक्त जमातींच्या आत्मकथनांनी मराठी साहित्य समृद्ध केले आहे. या आत्मकथनांची किती जागतिक पातळीपर्यंत गेली आहे. मराठी साहित्य विश्वाला अपूर्व असे योगदान या आत्मकथनांनी दिलेले आहे. कारण या आत्मकथनांतून अविष्कृत होणारे अनुभवकथन सामाजिक, सांस्कृतिक, आर्थिक व धार्मिक जीवन विलक्षण अनुभव देणारे आहे. भटक्या विमुक्त जमातींच्या आत्मकथनांमध्ये ग्रामीण व शहरी भागातील जीवन व्यक्त झाले आहे. ग्रामीण भागातील येणाऱ्या भटक्या जातीजमातींचे ते जगत, भोगत असलेल्या जीवनांचे चित्रण आत्मकथनात आले आहे. या आत्मकथनांमध्ये पहिल्या पिढीतील जी निडरता नव्हती. ती निडरता २००० नंतरच्या भटक्या विमुक्त जमातींच्या आत्मकथनात प्रामुख्याने आढळून येते.

२००० नंतर कालखंडातील भटक्या विमुक्त जमातींची आत्मकथने :

भटक्या विमुक्त जमातींची आत्मकथने ही सामाजिक जाणीव आणि उपेक्षित समाजाचे वास्तव असलेला दस्तावेज आहे. डॉ. बाबासाहेब आंबेडकरांच्या विचारातून निर्माण झालेली ही आत्मकथने पहिल्या पिढीतील आत्मकथनांपेक्षा सर्वार्थाने वेगळी, भिन्न ठरली आहेत. कारण ही आत्मकथने केवळ अनुकरणातून आलेली असून सजग जाणिवेने लिहिली गेली आहेत. त्यामध्ये 'बिराड' हे अशोक पवार यांचे आत्मकथन (२००१) साली प्रकाशित झाले. विमल मोरे यांचे 'तीन दगडांची चूल' (२०००), रामचंद्र नलावडे यांचे 'दगडफोड्या' (२०००), संतोष पवार यांचे 'चोरटा' (२००१), रमेश पिंग्या काळे यांचे 'पारध्याचं जिणं' (२००७), ज्ञानेश्वर भोसले यांचे

# Kinetic study of Fast brominations of regioisomers of Chloroacetanilide using Competition Techniques

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**ABSTRACT** - The competitive kinetics applied with assurance and determine the kinetic in milliseconds due to fast bromination reaction. Determination of kinetics is fundamental aspects for the design and operation of the reactor. Competition kinetic method was proposed to determine directly bromination rate constant of regioisomers of Chloroacetanilid Xylidine. The specific reaction rates determined from this study are  $1.7 \times 10^5 \text{M}^{-1}\text{S}^{-1}$  for *P*-Chloroacetanilide,  $1.8 \times 10^5 \text{M}^{-1}\text{S}^{-1}$  for *M*-Chloroacetanilide and  $1.3 \times 10^5 \text{M}^{-1}\text{S}^{-1}$  for *O*-Chloroacetanilide Kinetic evidence gives information about mechanistic route.

**KEYWORDS** - Regioisomers of Chloroacetanilide, Competitive kinetics, Bromine, Potassium nitrate, potassium iodide

## I. INTRODUCTION

Regio-isomers of Chloroacetanilide in the three competition reactions studied with the aim of maintaining the competition ratio nearly 1 and in view of the observed rapidity of the reactions. The concentrations of both the competitors are large and almost constant compared to that of bromine in the competition. The rate of reaction is an expression relating the rate of reaction to the concentration of the relating species present which may include reactant, product and catalyst<sup>1</sup>

Chloroacetanilide in which amide group is electron donating group it exerts +I effect and orienting ortho and para isomers. The reaction rate is influenced by certain external factors such as concentrations of the reacting substances, temperature and pressure.<sup>2</sup>

The Competition ratio  $V-v/v$  is operate in such manner as that of approximately 1. By using the equation rate constant can be calculated. Fast reaction will have a low activation energy, but if the reactants are present in low concentrations the rate of reaction will be small<sup>3</sup> The competition techniques are necessitated to study the kinetics of these brominations of aromatic substrate due to their rapidity.<sup>4</sup>

## II. EXPERIMENTAL METHOD

**Table 1 : Bromination of 2-chloroacetanilide**

Initial concentrations of the reactants in 100 ml reaction mixture

Sr. No.	Reactant	Concentration/M
1	Bromine	0.0025
2	2-chloroacetanilide	0.01
3	potassium iodide	0.04

Titre values  $V = 8.6 \text{ ml}$   $v = 4.9 \text{ ml}$

**Table 2 : Bromination of 3-chloroacetanilide:**

Initial concentrations of the reactants in 100 ml reaction mixture

Sr. No.	Reactant	Concentration/M
1	Bromine	0.0025
2	3-chloroacetanilide	0.01
3	potassium iodide	0.04

Titre values  $V = 8.6 \text{ ml}$   $v = 4.2 \text{ ml}$

**Table 3 : Bromination of 4-chloroacetanilide:**

Initial concentrations of the reactants in 100 ml reaction mixture

Sr. No.	Reactant	Concentration/M
1	Bromine	0.0025
2	4-chloroacetanilide	0.01
3	potassium iodide	0.04

Titre values  $V = 8.6 \text{ ml}$   $v = 4.5 \text{ ml}$

## III. OBSERVATION

Velocity constant  $K$  can be calculated with the help of following equation

$$\frac{k_1 [\text{Chloroacetanilide}]^x [\text{Br}_2]^y}{k_2 [\text{K I}] [\text{Br}_2]} \times \frac{V-v}{v}$$

When  $x$  and  $y$  are both taken as 1, over a variation of the concentration range of Chloroacetanilide, the velocity constant values  $k_1$  obtained for the bromination of Chloroacetanilide are found to be constant suggesting an overall order of second for the reaction in all the two reactions studied. The velocity constant values obtained.

**Fig.1 Mechanism of bromination reaction of Chloroacetanilide**

- I. Bromination of 2- Chloroacetanilide by molecular bromine



## REPRODUCTIVE CYCLES IN TWO GEOGRAPHICALLY SEPARATED POPULATIONS OF THE OYSTER *Saccostrea cucullata* FROM SINDHUDURG DISTRICT, MAHARASHTRA STATE, INDIA

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### Abstract:

Two geographically separated localities at Deogad (160 23' N ; 730 23' E ) and Achra ( 160 15' N; 780 26' E) in Sindhudurg district of Maharashtra State ,India were selected on the basis of the differences in habitat , topography ,vegetation and local market value to study the reproductive cycles of the oyster *Saccostrea cucullata*. The maximum sizes attained by *S. cucullata* in the estuaries at Deogad and Achra were 44-45 mm shell length. However, comparatively larger sized oysters are found round the year in the estuary at Deogad than at Achra.

The environmental parameters such as tidal heights, pH, temperature, dissolved oxygen and salinity existing on the oyster beds in Deogad and Achra were recorded on every new-moon and full-moon days for a period of twelve months.

The microscopic details of the gonad tissue processed on every new moon (NM) and full moon (FM) days of each month revealed following stages ; (i) Gametogenesis ; (ii) Maturing ; (iii) Mature; (iv) Partial spawning ; (v) Complete spawning ; (vi) Recovery ;(vii) Neutral . The gonads of twenty oysters were staged for males and females separately on each NM and FM days and percentage of the males and females in these different stages were calculated.

The study on reproductive cycle in male oysters of *S. cucullata* from Deogad showed that many oysters were in gametogenesis stage in entire June and once again on November NM. Maturing stage was seen on March NM, May FM, July NM and again on November FM and in entire December. Many oysters were in mature stage on March FM, April FM and July FM and again on January NM. Most of oysters were under spent stage on March FM, in entire August and September, and on January FM. Many oysters were under recovery stage on May NM and in entire October. Most of the samples collected in entire February and on April NM showed prominent neutral stage. The female oysters showed that the gametogenesis was dominant on March NM, in entire June and on November NM; maximum on NM of March and on November. The maturing stage was dominant in entire April and May and on July NM and December NM. Oysters under spent condition were dominant on April NM and December FM, and all the gametes were released in entire August, September and on October NM. The recovery stage was recorded in many oysters on October FM and January FM, while the neutral stage was recorded in entire February.

The male oysters from Achra showed gametogenesis stage on March NM, April FM and June NM. The maturing stage was seen in most oysters on April FM, June FM, July NM, September NM and FM. The mature stage was very conspicuous on July FM and November NM. Most oysters were in the spent stage on May FM , August NM ,October NM and December FM. Oysters under recovery stage were in high percentage on December NM , January NM and February FM. The neutral condition was most prominent in many oysters on March NM and January FM. The female oysters at Achra showed that many oysters under the gametogenesis appeared on April NM, June NM and December FM. The maturing condition in oysters was dominant on April FM, June FM, August FM, entire September and on February NM. Many oysters in mature stage occurred on October NM and November NM. The spent stage in oysters was dominant on December NM, In entire May and on July FM. The recovery stage was recorded in December NM, while the neutral stage in oysters was dominant on January FM and March NM. These different stages of the gonads have been correlated with the changes in environmental conditions over the oyster beds from the two localities. The results are discussed in the light of possible impact of the environment on reproductive events.

**Keywords:** *S. cucullata*, Deogad, Achra, FM, NM, gametogenesis.

### Introduction:

Along the west coast of India the backwaters and estuaries are very extensive and play an important role for food production. These are widely scattered and have an area of 30.7 lakhs acres (Mitra, 1970) from which Maharashtra coast constitutes 3.0 lakhs acres

## अठारहवीं सदी के महाराष्ट्र में भू-राजस्व व्यवस्था

प्रा.सुरेंद्र अर्जुन शिरसट

सहाय्यक प्राध्यापक  
कला, महाविद्यालय, भिगवण, ता.इंदापूर जि.पुणे

शोध सारांश:-

मध्यकालीन अर्थव्यवस्था में कृषि का अत्यधिक महत्व था। कृषि पर कर सरकारी राजस्व का सबसे बड़ा स्रोत थे। भारत में कृषि का महत्व प्रागैतिहासिक काल से ही रहा है। इसलिए प्राचीन और पूर्व मध्यकालीन ग्रंथों में कृषि से संबंधित कई संदर्भ मिलते हैं। कृषि आय के महत्व के कारण, सरकार ने खेती के तहत अधिक भूमि लाने का प्रयास किया है। भूमि की नियमित जुताई को प्रोत्साहित किया गया। भू-राजस्व एकत्र करते समय भूमि और फसल निरीक्षण बहुत महत्वपूर्ण था। पहले जमीन का सर्वे किया गया और फसल तैयार होने के बाद फसल का निरीक्षण कर कर का निर्धारण किया गया। मध्यकालीन शासकों निजामशाही के वजीर मलिक अंबर और छत्रपति शिवाजी महाराज ने एक बहुत अच्छी कृषि प्रणाली की स्थापना की जो बाद के समय में टिकाऊ बनी रही। अठारहवीं शताब्दी में, सरकार ने कृषि आय बढ़ाने के लिए सिंचाई सुविधाओं का निर्माण किया और बंजर भूमि रखने वाले किसानों पर एक बंजर भूमि कर लगाया।

किबर्ड : कुटीर उद्योग, बटाई, बिधावनी, चकबंदी, सारा, कास, टके / टका, रुका, पडीचा पैका.

मध्यकालीन शासनकी अर्थव्यवस्था में भू-राजस्व सबसे आय देनेवाला कर था। अधिकांश लोग खेती में लगे हुए थे। इसलिए, कृषि की प्रकृति, राजस्व संग्रह, कृषि से संबंधित अन्य महत्वपूर्ण विकासों का अध्ययन करना आवश्यक है। इस उद्देश्य के लिए वर्तमान मामले में विषय वस्तु तैयार की गई है। विषयवस्तु समझने के लिये में मुख्य रूप से अठारवीं सदी के प्रांत पुणे और तरफ पाटस प्रदेशों से उदाहरण शामिल हैं।

कृषि की खोज मानव विकास प्रक्रिया के इतिहास में एक मील का पत्थर थी। प्रागैतिहासिक काल से ही भारत में मानव संस्कृति के विकास में कृषि महत्वपूर्ण रही है। हड़प्पा संस्कृति में, बैलों द्वारा खींचे गए लकड़ी के हल से जुताई की जाती थी और गेहूं, जौ और कपास की सूखी खेती की जाती थी।<sup>1</sup> ऋग्वेद में मुख्यतः ४५०० से २५०० ईसा पूर्व के वैदिक काल के कृषि और कृषि जीवन की जानकारी मिलती है। आर्य अपनी आजीविका के लिए कृषि पर निर्भर थे। आज की कृषि प्रगति के बीज वैदिक कृषि में दिखाई देते हैं। आर्य भूमि की पूर्व जुताई कर रहे थे, बीज बो रहे थे और खरपतवार नियंत्रण के लिए फसल की अंतर-फसल काट रहे थे।

मिट्टी की बनावट और जलवायु के अनुसार फसलों का चयन किया गया। वेद ग्रंथों में हल, हल का फाल, कुदाल, चाबुक, सूप, दरांती आदि जैसे कृषि उपकरणों का उल्लेख है, जबकि अथर्ववेद में हल बनाने का वर्णन है।<sup>2</sup> प्राचीन काल में किसानों के पास निजी जमीन के साथ-साथ सरकारी जमीन भी थी और रबी के मौसम में फसलों का उल्लेख है ... बुवाई से पहले बीजों को संसाधित किया जाता था और फसलों की सिंचाई की सुविधा होती थी ... किसानों को वार्षिक कृषि उपज का भुगतान करना पड़ता था। अकाल के समय उन्हें सहायता मिलती थी... प्राकृतिक आपदाओं जैसे फसल की क्षति और सूखे से होने वाली बीमारियों, शत्रु सेना और जंगली जानवरों के कारण किसानों को माफ कर दिया जाता था।<sup>3</sup>

संत ज्ञानेश्वर द्वारा लिखित ज्ञानेश्वरी में ज्वार, धान, गेहूं, हरा चना, चना, तिल, सरसों, सूरजमुखी, गन्ना, कपास, नागवेल, लहसुन, प्याज, मिट्टी, लौंग, अदरक, हींग, तेज पत्ता, कद्दू और पड़वल सब्जियां, केला, कपूर केला,