



Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

MICROGRID : A SOLUTION TO RURAL ELECTRICITY PROBLEM

Rajib Lochan Dash

*Electrical Engineering Department, OSME, Keonjhar
Skill Development & Technical Education Dept, Govt. of Odisha.
rajibatbpd@gmail.com*

Abstract :

Electricity has become a part and parcel of life. Due to its vast application, it is now an essential ingredient of human civilization. But due to the depleting source of fuel used in power plant and transmission viability, rural India is facing many challenges in harnessing uninterrupted electrical power.

Micro grid which consists of renewable source of energy like solar wind along with energy storage device changing the life standards of many remote, distant rural village with a new hope of development and prosperity.

Keywords. *micro grid*

1. What is a Micro grid ?

The micro grid defined by CERTS (Consortium for Electric Reliability Technology Solution of the USA) is a micro power system including a cluster of loads, storage and multiple DGs. It can meet the requirement of power quality and reliability of power supply. It provides both heat and power to the local areas. Micro grid system is operated at a low voltage and it consists of several distributed energy resources such as solar panel, wind turbine, micro turbine and various energy storage devices such as flywheel, battery, super capacitors etc.



Micro grid can operate in two modes :

1. Grid connected mode
2. Islanded mode

Thus micro grid can effectively integrate various sources of distributed generation (DG), especially Renewable Energy Sources (RES) - renewable electricity, and can supply emergency power, changing between island and connected modes. The Fig 1 represents the overall components of a micro grid system.

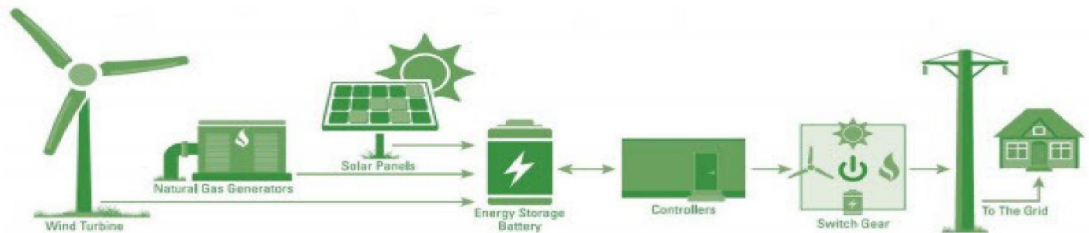


Fig.- 1

2. TYPES OF MICRO GRID

Micro grids are classified based on (i) Mode of operation (ii) Types (iii) Source (iv) Scenario and (v) size.

2. 1 DC Micro Grid

Many new distributed energy resources are direct DC, e.g. photovoltaic (PV) generation, stationary batteries, mobile batteries, and fuel cells. Also, many high efficiency loads are also direct DC Utilizing a DC bus in micro grid may avoid many of the power conversion steps required when using an AC bus, potentially leading to higher energy efficiency and improved economic operation.

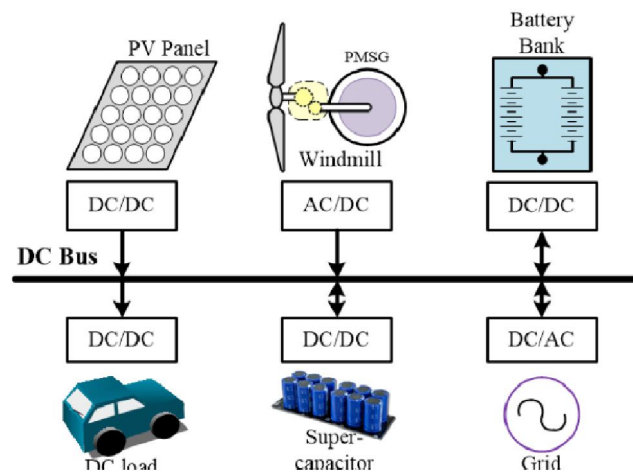


Fig.- 2

DC Micro grid having the following benefits

1. Increase the introduction of distributed PV units.
2. Reduce energy dissipation and facility costs resulting from AC/DC conversion by integrating the junction between a commercial grid and DC bus which connects PV units and accumulators.
3. Supply power to loads via regular distribution lines (not exclusive lines for emergency) even during the blackout of commercial grids. Figure 2 shows a schematic view of the DC micro grid system. This system utilizes a DC bus as its backbone and distributes power to a user end loads

2.2 : AC MICROGRID

DC generating units as well as energy storage will be connected to the AC bus via DC-to-AC inverters, and further, AC-to-DC rectifiers are used for supplying DC loads. In AC micro grid, all DERs and loads are connected to a common AC bus.

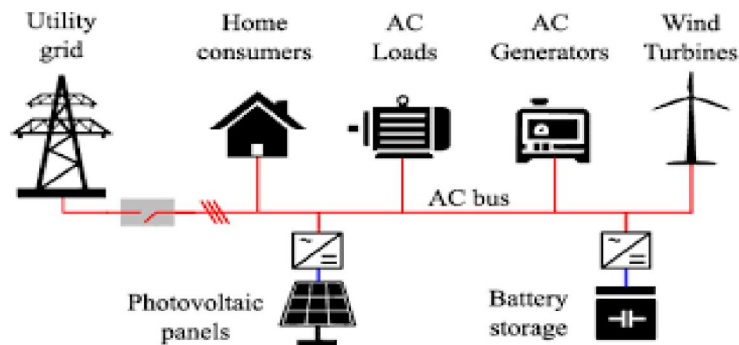


Fig.- 3

3. DISTRIBUTED ENERGY RESOURCES (DER) INTERFACES:

Power converters allow connection of independent equipment and components on a common system.

DGs technologies require specific converters and power electronic interfaces that are used to convert the generated energy to suitable power types directly supplied to a grid or to consumers.

4. Advantages of microgrid:

- Ability to disconnect from utility grid during disturbance and operate independently.
- It reduces demand on utility grid thus prevents grid failure.
- We can use both electricity and heat energy so that over all efficiency increases.

5. Disadvantages of microgrid:

- Resynchronization to utility grid is difficult.

6. Role of Ministry of new and non renewable energy ,India in promoting micro grid :

The Ministry of New and Renewable Energy (MNRE or the Ministry) aims to attain a sustainable growth in the country by securing the energy needs through renewable energy (RE) sources such as solar, biomass, water, wind etc. Along with the support to large scale RE, the Ministry promotes decentralized solutions based on sources such as solar, biomass, biogas, wind, small hydro etc. for meeting the lighting needs, other electricity and thermal requirements especially in rural areas through separate programmes. Over time, based on national developmental goals, these programmes have been reformed to focus on the replacement of fossil fuels, and providing energy access to the unserved and underserved populace.

Access to affordable and reliable electricity is crucial for spurring social and economic progress in rural India, and for meeting developmental aspirations. As per the International Energy Agency, World Energy Outlook 2015 report, India has 237 million people that have no access to electricity. The Government has delivered significant progress on rural electrification in the recent past through grid extension, however a large number of households in rural areas still have no access to electricity. Decentralized RE solutions are being deployed to address the last mile access challenge in rural areas in many parts of the country.

With reducing costs and increasing efficiencies of RE technologies, RE based Micro and Mini grids solutions are being perceived as a durable solution – able to provide reliable and cost-effective energy service, cater to productive and commercial loads, accommodate future loads, and connect with grid and feed surplus power if needed. Already, a few Energy Service Companies (ESCOs) have successfully deployed micro and mini grid projects in the country and many others are in the process of determining a viable business model. The Ministry wants ESCOs to implement RE based micro and mini grid projects, and in order to propel its deployment in the country it is empaneling interested parties as Rural Energy

Service Providers (RESPs). The RESPs will earn certain privileges for implementation under the Ministry's programmes. Certainly, many more such supporting and practical

measures will be required to encourage ESCOs and investors in to the micro and mini grid space. The Ministry is keen on working with States (and State Nodal Agencies) to build a supportive ecosystem for development – an environment able to minimize the risk associated with such investments, and mobilizes capital. As micro and mini grids are mainstreamed, it will enable in meeting the goals of reducing dependency on fossil fuels, providing clean power to rural households, and meeting their aspirational needs.

6.1 : Preamble

RE based micro and mini grids with its enormous potential are a promising solution to the access to energy challenge in the country. They offer the benefits of boosting local economy by meeting energy needs of residential and commercial activities thereby supporting enterprise development, generating employment opportunities, raising individual/ household incomes etc. The Ministry therefore plans to support its expansion on a large scale through its various on-going programmes. In this regard, the

Ministry is issuing a policy offering likely implementation solutions and approaches for overcoming common issues and challenges that hamper the growth of mini grid sector. The States are encouraged to refer to this policy document for developing their respective programmes, policies and regulations. The underlying principles of the policy are listed below:

- Mainstream RE mini grids for enhancing access to affordable energy services, and improving local economy
- Streamline project development procedures for ESCOs
- Provide operational frameworks to operate along with the Distribution Company (DISCOM) grid
- Optimize access to central financial assistance and other incentives
- Foster innovation in mini grid models to cater to rural needs.

6.2 : Scope of Policy

The objective of the policy is to promote the deployment of micro and mini grids powered by RE sources such as solar, biomass, pico hydro, wind etc. in un-served and underserved parts of the country by encouraging the development of State-level policies and regulations, that enable participation of ESCOs¹. The Ministry targets to achieve deployment of at least 10,000 RE based micro and mini grid projects across the country with a minimum installed RE capacity of 500 MW in next 5 years (taking average size as 50 kW). Each micro and mini grid project should be able to meet the basic needs of every

household in vicinity, and also aspire to provide energy for services beyond lighting such as fan, mobile charging; productive and commercial requirement.

Conclusion :

The potential of Indian villages to be a hub for distributed generation has paved the way of setting up micro grid which not only caters the need of individual but also export the surplus energy to the grid in grid connected mode. Working in a coordinated way can be a boom for our electrical energy security scenario creating a better living standard as well as making India power surplus country.

References

- [1] Rajesh, K. S., et al. "A review on control of ac microgrid." *Renewable and sustainable energy reviews* 71 (2017): 814-819.
- [2] Samal, Sarita, and Prakash Kumar Hota. "Design and analysis of solar PV-fuel cell and wind energy based microgrid system for power quality improvement." *Cogent Engineering* 4.1 (2017): 1402453.
- [3] Lal, Deepak Kumar, Ajit Kumar Barisal, and M. Tripathy. "Load frequency control of multi area interconnected microgrid power system using grasshopper optimization algorithm optimized fuzzy PID controller." *2018 Recent Advances on Engineering, Technology and Computational Sciences (RAETCS)*. IEEE, 2018.
- [4] Bhuyan, Sujit Kumar, Prakash Kumar Hota, and Bhagabat Panda. "Modeling, Control and Power Management Strategy of a Grid connected Hybrid Energy System." *International Journal of Electrical and Computer Engineering* 8.3 (2018): 1345.
- [5] Bhuyan, Sujit Kumar, Prakash Kumar Hota, and Bhagabat Panda. "Power Quality Analysis of a Gridconnected Solar/Wind/Hydrogen Energy Hybrid Generation System." *International Journal of Power Electronics and Drive Systems* 9.1 (2018): 377.
- [6] Samal, Sarita, and Prakash Kumar Hota. "Power Quality Improvement by Solar Photo-voltaic/Wind Energy Integrated System Using Unified Power Quality Conditioner." *International Journal of Power Electronics and Drive Systems* 8.3 (2017): 1424.





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

Innovative Nano Composite in Automobiles

Soma Dalbehera,

Mechanical Engineering Department, GP Nayagarh

somacutm@gmail.com

Abstract :

Need of mobility all across the world is increasing exponentially. This is also an important prerequisite for the progress of modern society. In the past, automobile has played a crucial role and shall continue to play a dominant role in the progress of society. The demand of automobiles is increasing rapidly especially in the countries like China, India, Brazil and Korea. The rising economies of these countries will further increase the demand of automobiles. In order to achieve safety, comfort and environment friendliness, automobile companies are investing heavily in research and development. In this context, nanotechnologies are likely to play an important role. Nanotechnology is opening new doors for innovative products and imaginative applications in automobile sector. This paper focuses on the recent trends and future innovative nanotechnology applications in automobile industry.

1. Introduction :

Nanotechnology is one of the most significant research areas to emerge in the past two decades or so. It is based on the concept of creating applications based on components built at the very small scale. Nanotechnology is the engineering of materials on the scale of 1 nanometre (nm) to 100 nm, a nanometre being 1 billionth of a meter. At this level, the basic physical laws governing macro objects undergo a drastic change. A macro particle is a cluster of atoms arranged together in random order. The formation of the structure is left to nature, and control over the properties of the material is difficult. Nanotechnology, on



the other hand, is a bottom-up approach where materials are created by placing individual atoms together. This decreases the randomness in the structural formation, enabling significant control over the properties of the material. Mechanical properties such as strength, ductility, and resilience can all be incorporated into one material. Nanotechnology is the understanding and control of matter at dimensions of roughly 1-100 nm, where unique phenomena enable novel applications. A nanometer is 10^{-9} of a meter; a sheet of paper is about 100,000 nm thick. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale. At this level, the physical, chemical and biological properties of materials differ in fundamental and valuable ways from both the properties of individual atoms and molecules or bulk matter.

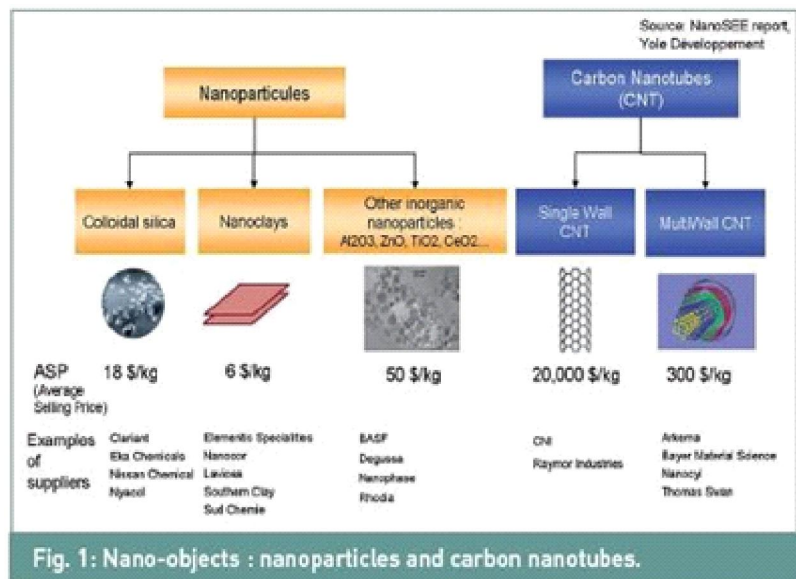
Nanotechnology offers many benefits to various aspects of entire spectrum of industry. The automotive industry is also not untouched by the brewing nanotechnology revolution. Nanotechnology enhanced materials have already started beginning to improve the performance and cost-effectiveness of automobiles, and in coming years it will further become more and more viable as stronger, lighter and harder nonmaterial are commercially available. Although, a large number of nano-structures have been investigated till now, however, the most significant among them are synthesized from single atomistic layers of carbon. These structures include hollow ball shaped “Bucky balls” (Fullerene-C60), Carbon nano tubes (CNTs) and grapheme sheets which have a very interesting range of mechanical, thermal and electrical properties [1]. A large number of nanomaterials such as metal nanoparticles, nano-powder, nano-adhesives, nano coatings, are being increasingly used in automotive applications.

1. 1 Nano-composites

A nanocomposite is defined as a solid matrix (usually polymers) that contains a nanoscale filler, called a nano-object (for example nanoparticles, nanotubes, nanofibres, etc.). The main characteristics of nano-objects are increased surface area (contact between the particle and its environment): this gives increased interaction between the particle and the surrounding matrix, resulting in improved mechanical, chemical, and thermal properties (1 g of particles of 25 nm has a surface area of 20 m²); and 2) transparency: when the particle diameter is lower than 30 nm, the reflection of visible light is negligible.

Nano-composites are a mixture of a conventional material with a nano-scale material. In the case of Polymer-Clay Nano-composites, the clay particles act as the nano material.

Nano-composite materials combine bulk properties of conventional materials with the size-dependent properties of nano-scale materials to create composite materials with novel properties. The range of potential nano-composite materials is infinite. These characteristics are the drivers for the development of nano-objects. Thus, there is a wide range of nano-objects available on the market or under development today. Although nanotechnology is considered as a recent science, some of these nano-objects have been sold for decades, even in millions of tons per year. Examples of these are primarily nanoparticles: carbon black, precipitate and fumed silica, etc. Relatively new nano-objects have already found commercial applications, showing real added value when compared to older particles. These nano-objects are (see Figure -1)[2]



The automotive industry is one of many fields of applications that have seen the growing impact of nanomaterials. Nanomaterial products are finding uses in the automotive industry for a variety of functions. Examples are

- fuel-borne catalysts for soot prevention in particulate filters,
- tires reinforced with nanoparticles for better abrasion resistance and improved gas permeability,
- car coatings exhibiting greater scratch resistance and improved gloss,
- anti-fog coatings for headlight and windshield that are highly hydrophilic, forming water films instead of droplets,

- Structural plastic parts combining higher mechanical performance with reduced weight.

General Motors showed the first commercial use of nanoclays in cars in 2002, with the Chevrolet Astro and GMC Safari vans. The step-assist was made of thermoplastic olefin filled with 3% nanoclays. It was much lighter, stiffer, and less brittle at cold temperatures than those made with the conventional talc filler. Although this application drew large media coverage, it has since been terminated. In 2004-2005, GM released the Chevrolet Impala with a body side trim made of nanoclays. A weight savings of 3 to 25% was achieved on the redesigned parts, but their performance is questioned. In 2005, GM's Hummer H2 SUT cargo bed trim contained 3 kg of nanoclays per car. Other car manufacturers commercialising Nano clay- filled parts include Maserati, Daimler Chrysler and Audi. Maserati engine bay covers are made of Ube nylon-6 nanocomposites, containing 2% nanoclays by weight.

2 : Benefits and Challenges of nanocomposites

The advantage of nanocomposites over conventional composites is that their mechanical, electrical, thermal, barrier and chemical properties such as increased tensile strength, improved heat deflection temperature, flame retardancy, etc. can be achieved with typically 3-5 wt. % loading of the nanomaterials such as clays, nanotubes and nanofibers while the latter require a high content of the inorganic fillers from 10 wt. % to as much as 50 wt. % in general, to impart the desired properties. Another advantage of nanocomposites is that the strength, shrinkage, warpage, viscosity and optical properties of the polymer matrix are not significantly affected. The enhanced properties are attributed to the structure and morphology of the nanocomposite, as they (clays/polymer) contain organically treated clays such as hectolite, montmorillonite, and synthetic mica as well as nanotubes (carbon nanotubes, halloysite nanotubes). These nanomaterials have a large aspect ratio (1000:1) and each one is approximately 1 nm thick and hundreds or thousands of these layers are stacked together with weak Van der Waals forces to form a clay particle, resulting in subsequent exfoliation in which the individual layers are peeled apart and then dispersed throughout the polymer matrix. The excellent degree of exfoliation, which results in smaller particle sizes and provides the greater surface area to interact with the host polymer, results in improved performance. CNTs-enabled nanocomposites are also receiving attention as a mechanical reinforcement and electrically conductive additive for automotive fuel system components requiring electrical conductivity. However, there are still many limitations and challenges for nanocomposites production. These include:

2.1 : Processing of nanocomposites

Compatibility, dispersion and exfoliation between nanomaterials and polymer matrices. Only a limited number of plastic matrices (mostly thermoplastics) are compatible with nanoclays/nanotubes/nanofibers as intercalation of clays with the precursor of a polymer can change the functionality of the polymer and inhibit its properties.

Cost : The production of nanocomposites on a commercial scale at viable prices, as polymer matrix price depends on crude oil prices and CNTs price is also high.

Consistency and reliability in volume production : It is possible to get consistency and reliability in volume production materials to a great extent. However, particle size distribution and control in volume manufacturing is not so easy.

High lead time : Commercializing the end-use products would take a longer time, mainly due to stringent approval and OEMs acceptance.

Oxidative and thermal instability of nanoclays : Commonly used organoclays are thermally unstable due to exchange of metal cations in clay galleries with organic ammonium salts and can degrade at temperatures as low as 170°C. It is clear that such organoclays are not suitable for most engineering plastics that are fabricated by melt processing technology[3].

3. Future Development and Directions

It is quite evident from the foregoing discussion that polymer nanocomposites are finding many applications in the automotive industry, and the market for these materials is on the path of growth and expansion. The OEMs/Tier I, Tier II, Tier III, raw materials/nanointermediates manufacturers, researchers and technologists are realizing that other than clays, nanomaterials like graphene, carbon nanofibers, nanofoams, multiscale hybrid reinforcement and graphene-enabled rubber nanocomposites could drive the market dynamics.

4. Functional Advantages of Nanotechnology

Nanotechnologies can be utilized in a wide range of industries owing to unique effects and functional properties. Functional advantages which are direct fallout of unique properties of nano materials are described here under.

4.1: Mechanical Properties

The demonstrated improved mechanical properties of nanostructure material are higher hardness, increased breaking strength at low temperatures or super elasticity at higher temperatures. The mechanical properties exhibited are due to decrease in grain size resulting in dimensions below which deformation mechanism does not occur in grain itself. These

benefits can be translated in terms of lightweight materials, increased durability of components and effective lubricating system.

4.2 : Geometric Properties

At contact surfaces, a crucial reaction between gaseous or liquid and solid substances takes place at nanoscale. Interaction in different medias therefore requires special physical and chemical properties of the surface of the particles, fibres, pores and the products. With regard to protection function, these demands include resistance against oxidation, corrosion, mechanical abrasions and high temperature. Because of the small size of nanostructures, the extreme surface-to-volume ratio of these materials becomes more important. Therefore, large specific surface and the surface properties of nanostructured materials influence chemical activity. Due to pores at nanometer range, materials can exhibit properties which can be used in nanofilters.

4.3 : Optical Properties

Since nanoparticles are very small as compared to the wavelength of the visible light, no reflection occurs from these particles. Dispersion effect is also demonstrated by nanoparticles which can cause colour effect. By altering the size of the nanoparticles, desired wavelength region can be achieved for intended application. Therefore, the optical property such as light absorption and emission behaviour gets altered. The fact nanoscale features are smaller than the wavelength of visible photons, also impacts light scattering, enabling the design of nanocrystalline ceramics that are as transparent as glass.

4.4: Electronic Functionalities

In the nanometer range, quantum effects take place that cannot be observed in larger objects. Charge carriers that can move freely in volume of solid material are strongly influenced in their mobility by nano objects given their small dimensions. The behaviour can also be observed in a material with macroscopic dimensions consisting of nanocrystalline crystallites separated by grain boundaries. Scattering of charge carriers on boundary surfaces affects several electrical properties. Therefore, an increase in the specific electrical resistance in comparison to a material with crystals in the micrometer range can often be observed. The manipulation of the grain size of such a material allows turning of the electronic properties [4].

5. Nano composites drive opportunities in the automotive sector

Nanocomposites are an emerging class of polymeric materials exhibiting excellent mechanical properties, enhanced modulus and dimensional stability, flame retardancy,

improved scratch and mar resistance, superior thermal and processing properties, reduced warpage of components and enhanced impact resistance making them suitable to replace metals in automotive and other applications[3]. The key drivers for the use of polymer nanocomposite-enabled parts in the automotive industry are reduction in vehicle's weight, improved engine efficiency (fuel saving), reduction in CO₂ emissions and superior performance (greater safety, increased comfort and better drive ability). The commercialization of polymer nanocomposites started in 1991 when Toyota Motor Co. first introduced nylon-6/clay nanocomposites in the market to produce timing belt covers as a part of the engine for their Toyota Camry cars, in collaboration with Ube industries in 1991. At about the same period, Unitika Co. of Japan introduced nylon-6 nanocomposite for engine covers on Mitsubishi GDI engines manufactured by injection moulding, the product is said to offer a 20% weight reduction and excellent surface finish. In 2002, General Motors launched a step-assist automotive component made of polyolefin reinforced with 3% nanoclays, in collaboration with Basell (now LyondellBasell Industries) for GM's Safari and Chevrolet Astro vans, followed by the application of these nanocomposites in the doors of Chevrolet Impalas.

Nanoclays also offer a reduction in relative heat release, excellent dispersion and exfoliation, excellent flame retardant synergy, and reduced weight. Polyolefin is commonly used as host polymer and thermoplastics such as polyamide (nylon), Polyphenylene Sulphide (PPS), Polyetheretherketone (PEEK), Polyethylene terephthalate (PET), polycarbonate, thermosets such as epoxy, and thermoplastic elastomers such as butadiene-styrene diblock copolymer are also used in more demanding automotive applications. The use of thermoplastics as a matrix material in nanocomposites has been growing steadily, especially in automotive applications, largely due to the material's low cost, high performance, low density, longer shelf life, easy dispersion and processing with nanomaterials, ability to regrind, and recyclability. Thermoplastics also offer enhanced mechanical, thermal, electrical and barrier properties, excellent fracture toughness over thermosets as well as the ability to be easily joined by mechanical joining and welding techniques[5].

5.1: The list of specific automotive nanotechnology applications includes at least the following:

- Lightweight structure materials
- Fire-resistant and thermal protection materials
- Strength, hardness and duration improvement

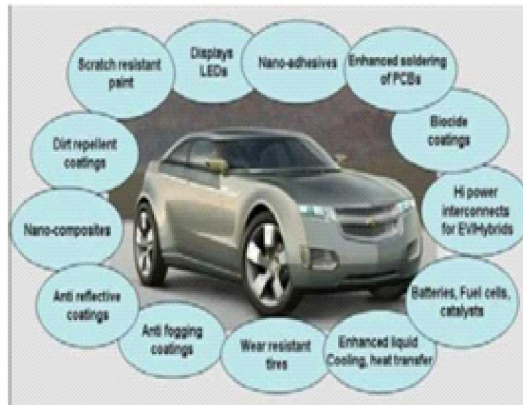
- Functional paint and coating/smartskins
- Self-cleaning
- Scratch-resistant
- Anti-corrosion
- Color effects
- Optical performance
- Programmable materials
- Other functional materials

5.2 : Nanotech-based energy generation and storage

- Fuel cells
- Solar cells
- Gasoline catalyst
- Energy storage
- Ultrafine sensing and monitoring
- Motion monitoring
- Pressure monitoring
- Inclination monitoring
- Biometric systems
- Climate sensing
- Nanoelectronics
- Smart-engine management
- Displays and lighting
- High-temperature electronics
- Security controlling
- Long-lasting batteries

6. Applications of Nanotechnologies in Automobiles

Nanotechnology offers great promises of innovative products and sustainable solutions to entire cross section of industry. Automotive industry is set to get benefited with research and development taking place in nanotechnology. The nanotechnology enabled products



have already started showing its presence across automotive industry by way of enhanced performance and cost effectiveness. The industry requirements of increased fuel efficiency, safety and comfort, environmental safety etc are set to be revolutionarised by nanotechnology. As on date, a large number of nanotechnology applications are in use in automobile industry.

Figure 1 Automotive applications of nanotechnology

6.1: The most promising automotive applications of nanotechnology include the following:

- Improved materials with CNTs, grapheme and other nanoparticles/structures
- Improved mechanical, thermal, and appearance properties for plastics
- Coatings & encapsulates for wear and corrosion resistance, permeation barriers, and appearance Cooling fluids with improved thermal performance
- Joining interfaces for improved thermal cycle and crack resistance
- Metal alloys with greater mechanical strength
- Metal matrix and ceramics with improved mechanical properties
- Solder materials with crack resistance or lower processing temperature
- Displays with lower cost and higher performance
- Batteries for electric vehicles and fuel cells with improved energy capacity
- Automotive sensors with nano-sensing elements, nanostructures and nanomachines
- Hybrid electric vehicles using electrical interconnects for high-frequency and high power applications

- Electrical switching including CNT transistors, quantum Transistors, nano-electromechanical switches, electron emission amplification, and more efficient solar cells
- Self-assembly using fluidcarriers.

6.2 : Nanotechnology for Car Body

Keeping in mind the safety of the automobile occupant, it is important to develop nano structured materials which can offer high strength to take care of the high intensity impact during crash. Light weight would also lead to reduced fuel consumption and thus economy in operation.

6.3 : Nano Steel

Crash safety and lightweight are the two major issues which are required to be addressed. A high strength yet light weight material for car body can be produced by using nanotechnologies. It has been reported that embedded nano particles of metallic carbon nitride can effectively increase the strength of steel. In long term loading tests of up to 10,000 hours, it was observed that a share of 0.002 percent of finely dispersed carbon can increase the stability of the steel significantly. The small size of only five to ten nanometer of carbon nitride is responsible for the outstanding properties.



Figure 2. Nano Steel

6.4 : Corrosion Protection

Another desired characteristic of automotive parts is corrosion protection. Widely used Chrome III (Cr^{3+}) does not offer long term protection. By the use of nanotechnologies it has been made possible to enhance protection by the use of SiO_2 nano particles in the electrolyte. The passivation achieved through galvanization processes consists of a Cr^{3+} enriched layer and a layer containing SiO_2 nano particles in Cr^{3+} matrix.

6.5 : Nanotechnology for Chassis and exterior

Reduction of the automobile weight is the primary concern of the automobile manufacturer. The reduced weight of the automobile leads to reduced fuel consumption and emission of exhaust fumes.

Nanotechnologies can give rise to lighter and more resistant materials by incorporation of nano particles or by the control of structure at nano scale. It is possible to achieve same mechanical strength with less and lighter material with enhanced performance.

Nano engineered thermoplastic materials allow a weight reduction of up to 40% compared to traditional steel chassis parts. With regard to paints and surface coatings, nanostructured surfaces result in improved paint adhesion and colour durability. Self-cleaning will become standard on windscreens and car body shells. Scratch-resistant, dirt repellent, UV- resistant and self-healing car paints are applications that already exist or are in development. Tire needs good grip its rolling resistance has to be low as well. Some 30% of the tire cover consists of reinforcing filler which makes possible wanted properties such as grip, abrasion resistance, resistance to initial wear and tear, and tear propagation. There are three products that significantly improve the properties of natural rubber: soot, silica and organosilane. Now being produced in nanoscale form, these particles as well as the crosslinking with the natural rubber molecules play a key role for tire properties.

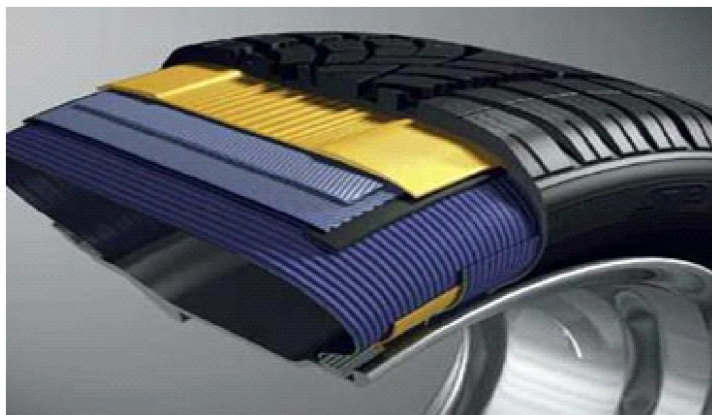


Figure 3 Nano Tyre

6.6 : Ultra-Thin Layers for Mirrors and Reflectors

Carbon black was the first nanomaterial to be used by the automotive industry in tires as a pigment and reinforcing agent. The key to tire performance is the mixture of the rubber but its optimization requirements can be contradictory (highly complex chemical

and physical interactions between the rubber and the filler material): While the Nowadays, large amount of glass is processed in a car with major chunk used for windscreen and window panes. Nanotechnology holds great promise in reducing the weight of the glass by the substitution of mineral glass by polymer glass. in order to make polymer glass scratch and impact resistant , it is coated with paints having extremely hard aluminum oxide nano particles placed in the substrate matrix during the hardening process resulting in high abrasive resistance with increased impact strength.

6.7 : Nanotechnology for Engine and Transmission System

Nanotechnology is also key to improving fuel cell performance of future generations of hydrogen- powered cars. One of the leading fuel cell technologies developed, in particular for transportation applications, is the proton exchange membrane (PEM) fuel cell, also known as polymer electrolyte membrane fuel cells – both resulting in the same acronym PEMFC. These fuel cells are powered by the electrochemical oxidation reaction of hydrogen and by the electro reduction of the oxygen contained in air. Although nanotechnology promises cheap bipolar materials using nanocomposites, more efficient non-platinum electro catalysts, and thermally stable and more durable membranes to become available in the near future, the precious metal platinum still remains the workhorse of PEM fuel cells. One way to minimize platinum usage is to increase catalytic efficiency by nanostructuring the platinum metal; another way of eliminating the use of platinum altogether is by exploring the use of much cheaper non- precious metal catalysts where the nanostructured surfaces match or exceed the catalytic properties of platinum.



Figure 4 Nano Technology in Reduction Friction Amongst Moving Parts

For fuel cell cars, hydrogen sensors will be a critical component for safety and widely needed. They will detect leaks long before the gas becomes an explosive hazard. Researchers have already developed thin, flexible hydrogen sensors using nanostructured materials, i.e., single-walled carbon nanotubes decorated with palladium nanoparticles. Of course, we will be stuck with gas-guzzling cars for quite some time to come. Improved fuel efficiency and the reduction of harmful exhaust emissions are two key areas where nanotechnology applications will make an impact. In today's automobiles, 10-15 per cent of the fuel consumption is influenced by engine friction due to the friction loss at the moving mechanical parts (piston, crank drive, valve drive). Nano coatings applied to mechanical parts, and nanostructured lubricants, help reduce friction and abrasion and thereby improve fuel efficiency

6.8: Reduction in Exhaust Emission

Modern automobiles are able to reduce exhaust emission by the use of catalytic converter which consist of high grade steel housing that include catalytically active materials used for conversion of pollutants to nitrogen, steam and carbon dioxide. Nanotechnology plays an important role during conversion of toxic to non-toxic gases. If the material used for the catalytic function is scaled to nanometer range, the specific surface increases drastically. The composition is designed in such a way that the exhaust gases can optimally interact with coating thereby increasing the rate of chemical transformation into harmless substances.

7. Conclusion

The automotive industry will be influenced by the development and implementation nanotechnology. It is our hope to raise the awareness that nanotechnology will positively influence the business of the automotive industry over the next several years. Due to the small size of nano-materials, their physical/ chemical properties (e.g. stability, hardness, conductivity, reactivity, optical sensitivity, melting point, etc.) can be manipulated to improve the overall properties of conventional material.

Automobile industry is set to be influenced by the development taking place in the field of nanotechnology. Due to small size of particles in nano range, their chemical and physical properties can be altered to improve the overall properties of conventional material. Increased surface area of the metal nano particles results in significantly enhanced reactivity in a catalytic converter thereby resulting in reduction of emission. Other fields where nano technology is likely to be employed gainfully are cooling systems for efficient heat transfer

and use of nano-magnetic fluids in shock absorbers to increase vibration control efficiency. High efficient nano layers of semiconductor materials provide electronic components and systems with a longer lifetime. Sensors based on nano-layer structures find applications in engine control, airbag, antilock brake and electronic stability program systems. Nanotechnology is therefore likely to influence the auto industry in a great deal and shall deliver features and products which are not scalable today.

8. References

- [1] Edward Wallner, Bruce Myers, DHR Sharma, Suresh Shah, Suresh Chengalva, Gary Eesely, Coleen Dykstra, Richard Parker and David Ihms, “Nanotechnology Applications in Future Automobiles”, SAE International, December 2010.
- [2] Nanotechnologies in Automobiles –Innovation Potentials in Hesse for the Automotive Industry and its Subcontractors, Vol 3, December 2008.
- [3] F Monfort-Windels and J Lecomte, “Nanotechnologies and their applications, Article 3, January 2008.
- [4] Keblinski P., Eastman J.A., Cahill D.G., Materials Today, p.36 (June 2005). Marquis F.D.S., Chibante L.P.F., Journal of Materials, p. 32 (December 2005).
- [5] Automotive Nanotechnology: Big Rewards and Big Risks From the Inconceivably Small By Ronald C. Wernette, Esq. Bowman & Brooke VOLUME 30, ISSUE 10 / NOVEMBER 9, 2010





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

Writing a Scientific Paper : An Art

Biswajit Parida

*Mechanical Engineering Department, Govt. Polytechnic Kendrapara,
Skill Development & Technical Education Deptt., Govt. of Odisha.
bisu_katak@rediffmail.com*

Abstract :

In this article the author has put an effort in the art of writing a scientific paper. As a scientific paper states, explains as well as justifies a particular work, it should be communicated to the entire science fraternity in a proper way. The clarity of the work lies in how it would be represented in pen and paper. The various steps involved in writing a paper are highlighted in the current work.

Keywords. *Scientific, Paper.*

1 : What does a Scientific Paper mean?

If the data, hypotheses and a result can be described in an organised manner it can be put forth as a scientific paper. Being the central part of a research a paper should be intended to instruct the reader. If a research work does not lead to papers despite of being interesting, it becomes non-existent or it might just equivalent to not have been done. The author should realize that the research objective is to formulate and test hypotheses and to draw conclusions from the carried out tests. More importantly these conclusions need to be shared with others and taught to the readers. The objective solely is not to collect data.

A paper is not meant to be like an archival device for storing a complete research work. It also gives a planning structure for the research work in progress. This can be very much useful in organising and conducting the work. A research programme will be a good one if it has a good outline. Throughout the work the plans or outlines should be written

and re-written on a regular basis. The research work begins with the plan and ends with the outline. The efficiency of the author will be immensely enhanced by pitting a continuous effort for understanding, analysing, summarizing and then finally reformulating the data rather than just to collect and only start to organize them when their collection is complete.

2 : Outlines of a Paper

2.1: The Reason for Outlines

An outline is a written plan of the organisation of a paper which includes the collected data on which it rests. In writing papers, preparing seminars and research planning the central place of an outline should be emphasized. The outline rather than just an outline of text should contain an appropriate presentation of data carefully in an organised way with relevant objectives, hypotheses and conclusions. Every outline itself contains little text. Once the data and organisation is complete, the supporting texts can be assembled easily.

The text has no meaning if we don't agree on the outline. The data organisation part of a paper consumes most of the thought and goes into the analysis where much of the time in writing a paper goes into the text. It is always an efficient practice to write several cycles of outlines before beginning to write text as writing different versions of the full text is slow. All writings we need to do (papers, reports, proposals, slides for seminars etc.) should be from outlines.

2.2 : How an Outline should be constructed?

As per the classical approach the start of an outline is with a blank paper piece in which all important ideas that is concerning us to a paper is written in any order. Then following set of questions are need to be asked to ourselves:

- *Why did we do this work ?*
- *What does it mean ?*
- *What hypotheses did we mean to test ?*
- *What ones did we actually test ?*
- *What were the results ?*
- *Did the work yield a new method ?*
- *What measurements did we make ?*
- *What parameters ?*
- *How were they characterised ?*

The possible equations, figures and schemes is sketched. If we start the research to test one hypothesis and found that the same data seem to test some other problem/hypothesis better, then no need to worry. We have to write them both down and pick the best combinations of hypotheses, objectives and data. More often the objectives of a work when it is finished are different from those used to justify starting the work as much of good science is opportunistic and revisionist.

Once we have written what we can then the organisation of the same is to be started with a separate piece of paper. All these ideas should be into three major heaps.

(a) Introduction

- Why the work has been carried out ?
- What are the major motivations behind the work and hypotheses ?

(b) Results and Discussion

- What were the results ?
- How the experiments were made and characterised ?
- What was measured ?

(c) Conclusion

- What does it all mean ?
- What hypotheses were proved and disproved ?
- What did we learn ?
- Why does the work make a difference ?

The next part is to organise each of these sections to a finer scale and the complete concentration should be on organising the data. For a clear presentation of the data the figures, tables and schemes are to be constructed. This process can be slow such as we may have to sketch a figure five to ten times in different ways to decide which one is the most clear and looks best aesthetically. Finally everything (outline of different sections, tables, figures, equations etc.) needs to be put in a good order.

When we are satisfied that we have included all the data or there is a need of collecting some additional data, the organisation of the data starts. Then we have to indicate where missing data will go, how we think they will look and how we will interpret them if our hypothesis is correct. This outline is taken to someone else to add his/her opinions, suggestion for changes and will be returned back. When all are agreed, the data is usually in its final form the writing can be started with some assurance that much of our prose will be used.

Under any circumstances we should not wait for the complete collection of the data before starting to write an outline. In real no research work is ever complete and it saves enormous effort and substantial amount of time to propose a reasonable paper and outline as soon as the basic structure of the project is visualised. The effort of writing an outline will always have helped in guiding the research.

2.3 : The Outline

An outline should contain:

- (a) *Title*
- (b) *Authors name and address*
- (c) *Abstract*

It need not to be written initially and can be done once the paper is complete.

- (d) *Introduction*

Particular attention must be given for the first sentence. Ideally it should state the objective of the work in a concise manner and indicate the importance of this particular objective. Generally the introduction should have following elements:

- The work *objective*
- The *justification* for these objectives with the importance of the work.
- The *background* of the What else work has been done by others ? How ? and What have we done previously, if any?
- The *reader* must be *guided* in a context that: What he is watching for in the paper ? What are the interesting points? and What strategy we used in the work ?

- (e) *Experimental*

In includes the correct order of all the experimental works/methods in different subheadings or paragraphs correspond to the order in the result section. Also images, if any need to be presented for better understanding of the work.

- (f) *Results and Discussion*

Usually the results and discussions are presented in a single combined section. This section should be segregated as per the important major topics. There should be subheadings for separate parts to make the organisation of this section more clear. It will help the reader to mark out the important segments by scanning through the final text. The following list includes examples of phrases that might be section headings:

- Evaluation of SN ratio

- Analysis of variance
- Calculation of percentage contribution
- Macrostructure
- Microstructure and fractography

As possible these sections are to be made as specific and rich with the information. Significant amount of text need not to be written in the outline but all the data should be in their proper place. Any text should simply indicate what will go in that particular section. The followings are the point marks:

- Section Headings
- Figures with captions
- Equations with number.
- Tables in appropriate format

A paper need to be considered as a collection of experimental results, summarized in a clear and economical manner with the help of figures, tables, equations and methods. The text is secondary and used just to explain the data. The paper will be short and readable if more information can be compressed into tables, equations etc.

(g) Conclusion

The conclusions of a paper are to be summarized in the outline as a list of short sentences. Whatever is there in the result section should not be repeated unless special emphasis is required. It is not a summary rather should indicate the significance of the work.

2.4 : In Summary

- Writing of the possible outlines for a paper should be started early in a project. We need not wait till the end because it may never come.
- The paper and its outline is to be organized through an easily assimilated data such as tables, figures, equations, schemes etc. rather than around the text.
- Organization should be carried out in order of importance not in chronological order. The weight given to different topics in a paper on the basis of its importance is very much vital. Most of the readers normally don't care how we reached into our significant results; they are more interested in what they are. So the paper should be started with the most important results first and then the secondary results later, if at all. A paper of shorter size is easier and convenient to read than longer ones.

3 : Some Points of Style

ISSUES	NOT	BUT
• Nouns not to be used as adjectives	weld formation; reaction product	formation of weld; product of the reaction
• The word “this” must always be followed by a noun, so that its reference is explicit.	This is a faster process; this leads to defects.	This reaction is fast; this method leads to defects
• The experimental results are to be uniformly in the past tense.	Addition of heat gives quality.	Addition of heat gave quality.
• Use of the active voice whenever possible.	It was observed that the strength decreased.	The strength decreased <i>or</i> We observed that the strength decreased.
• All comparisons to be compared.	The strength was higher using copper powder.	The strength was higher using copper powder than aluminium.

4 : Conclusion

In this article an attempt has been made to convey the methods of writing a scientific paper. This may be based on some research work or on a survey/review. This writing will definitely guide the beginners who are involved in their research works in diverse areas and thinking of starting the documentation process of the same. Now a days though there are a lots of advanced technical writing methods have been evolved this work is for to start the documentation.

5 : References

- [1] Ma Z. Y., 2008 “Friction Stir Processing Technology: A Review”, Metallurgical and Materials Transactions, Volume 39A, March 2008 642-658.
- [2] Parida B. and Pal S. 2015, “An investigation to find an appropriate starting position and elimination of pin hole defect in FSW for maximizing the joint length” International Journal of Advanced Manufacturing Technology, DOI:10.1007/s00170-016-8555-y

- [3] Whitesides, George M. 2004 Whitesides' Group: Writing a paper. *Adv. Mater.*, 16, No. 15, August 4.
- [4] Parida B. and Pal S. 2014, "Statistical Analysis on Tensile Property of Friction Stir Welded Aluminium Alloy" International Institute of Welding – International Congress (ICIW 2014), 9-11th April, New Delhi.
- [5] Deqing Wang, Shuhua Liu, 2004 "Study of Friction stir welding of aluminum", *Journal of Materials Science*, Volume 39 1689 – 1693.
- [6] Parida B., Pal S., Biswas P., Mahapatra M. M. and Tikader S., 2011 "Mechanical and Micro-structural Study of Friction Stir Welding of Al-alloy" *International Journal of Applied Research in Mechanical Engineering*, I, 69 – 74, 2011.





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

INTERLINKING OF RIVERS

(A NEED OF THE HOUR)

Padmalochan Behera,

Lect.(Civil), Govt. Polytechnic, Sonepur

INTRODUCTION :

India is a blessed land of Rivers but sometimes the blessings became sorrows due to negligence and mis-management of resources. Recently we have seen some worst scenario of drought in western & South India while the North & East India was severely flooded at the same time. To avoid these conditions, the water from surplus river basin may be transferred to water deficit river basins which is known River Interlinking. The rivers to be interconnected through canals which will carry the water from one river to another. The concept of river interlinking was evolved in 1950s in United Nations. In India it was first suggested by Dr. K.L.Rao in 1972 to link Ganga with Cauvery. Later On 1982 Govt. of India establish an autonomous body National Water Development Agency (NWDA) to work on this aspect.

Necessity of Interlinking :

- The uncertainty of occurrence of rainfall and fluctuation in seasonal and annual rainfall creating the problem of drought and shortage of drinking water.
- The increasing population demands more food grains which may rise to 450MT from 200MT currently, for which the irrigation potential has to be increased.
- More importantly floods, which are recurring feature in India, flood damages increased to 5846 crores in 1998 from 52 crores in 1953.

- With increase in population, the per capita water availability declined from 5.20 Th.cu.m per annum in 1950 to 1.80 Th.cu.m per annum in 2000 and is expected to slip further to 1.34 Th.cu.m per annum in 2025.

One of the most effective way to solve these is inter basin transfer of water (interlinking).

Some Existing Interlinking Projects :

1. Lesotho Highlands Water Project :

It transfers water From Senqu river, Lesotho to Vaal River of South Africa. It diverts around 750 M m³ of water Per annum. In phase 1 construction it costs around \$2billion while the royalties and hydropower revenue was \$31billion in 2004 which is about 5% of GDP.

2. Kurnool Cudappah canal :

This project was built in 1863 by a private company which transfers water from Krishna basin to Pennar basin. It consists of 304 km long canal of capacity 84.9 cumecs which irrigates 52746 ha.

3. Telugu Ganga Project :

This project is currently implemented to meet the pressing need of water to chennai metropolitan area. It brings Krishna water from Srisailem reservoir through an open canal, first to Somasila reservoir in Pennar valley.

From Somasila, the water is taken through a 45 km canal to Kandaleru and then to Pondi reservoir in Tamil Nadu through another 200 km long canal. The canal also irrigates 2.33 lakh ha of land in Andhra Pradesh.

4. Ravi-Beas-Sutlej-Indira Gandhi Nahar Project:

Combines Beas-Sutlej link with Indira Gandhi Nahar project. It irrigates around 26.3 lakh ha. of land and generates 1354 MW hydropower at Bhakra Nangal.

NWDA and The Present status of ILR Project:

- National Water Development Agency (NWDA) was established in july 1982 under ministry of water resources of govt. of India to work on this perspective.
- It visualizes 30 interlinking projects i.e. Himalayan component(14 projects) and Peninsular component (16 projects).
- Its objective is to carry out detailed surveys and investigations of possible reservoir sites and interconnecting links in order to establish feasibility of the proposal of Peninsular rivers Development and Himalayan Rivers Development component.

HIMALAYAN COMPONENT:

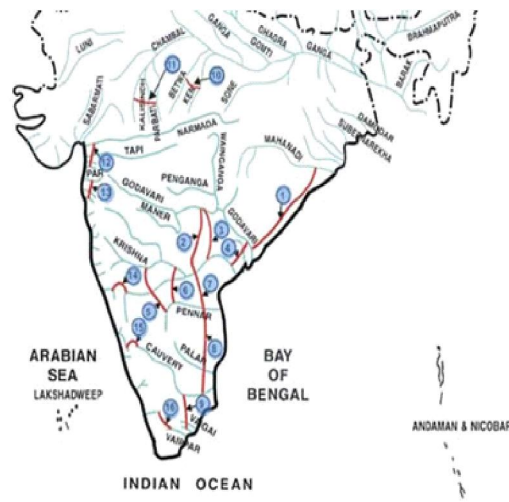
1. Kosi – Mechi
2. Kosi – Ghagra
3. Gandak – Ganga
4. Ghagra – Yamuna
5. Sarda – Yamuna
6. Yamuna – Rajasthan
7. Rajasthan – Sabarmati
8. Chunar – Sone Barrage
9. Sone Dam–Southern
10. Brahmaputra – Ganga (MSTG)
11. Brahmaputra – Ganga (JTF)
12. Farakka – Sunderbans
13. Ganga – Damodar – Subernrekha
14. Subernrekha – Mahanadi



(Himalayan Link Components)

PENINSULAR COMPONENT:

1. Mahanadi (Manibhadra)– Godavari(d/s)
2. Godavari (Inchampalli) – Krishna (Nagarjunsagar)
3. Godavari (Inchampalli Low Dam) – Krishna (Nagarjunsagar Tail Pond)
4. Godavari (Polavaram) – Krishna (Vijaywada)
5. Krishna (Almatti) – Pennar
6. Krishna (Srisilam) – Pennar
7. Krishna (Nagarjunsagar) – Pennar (Somasila)
8. Pennar (Somasila) – Cauvery (Grand Anicut)
9. Cauvery (Kattalai) – Vaigai –Gundar
- Tributaries of Ganga
10. Ken – Betwa
11. Parbati – Kalisindh – Chambal
12. Par – Tapi – Narmada
13. Damanganga – Pinja
14. Bedti – Varda
15. Netravati – Hemavati
16. Pamba – Achankovil – Vaippar



(Peninsular Components)

NWDA has prepared the preliminary reports of all the ILR projects and submitted to concerned state governments for their consent while the feasibility report of 2 links i.e. Sarda-Yamuna & Ghaghara-Yamuna has been completed and the survey & Investigation of other projects are under process due to international boundaries.

Govt. of Odisha submitted proposal for taking up three intra-State links. The PFR of Mahanadi-Brahmani intra-State link was completed by NWDA and not found techno-economically viable. The PFRs of two more links viz; (i) Mahanadi-Rushikulya Link Project (Barmul Project) and (ii) Vamsadhara-Rushikulya (Nandininalla) Project have been completed.

Barriers to Overcome:

- The main barrier is high initial investment i.e. around 5.6 lakh crore.
- Rehabilitation which is not an easy task.
- Environmental cost i.e. deforestation and soil erosion.
- Pollution of one river may transfer to another river.
- Political dispute between states.

Advantages of ILR:

- The major benefit is flood control. As the surplus water which causes flood is diverted to another river.
- Water will be easily available for irrigation leading to increase in food production and drought eradication.
- Generation of hydroelectric power, it will be around 25000 MW.
- Sufficient drinking water will be available.
- Huge employment generation.
- Inland navigation.
- Increase in National integration.
- Socio-Economic development.

Conclusion:

Though it has some disadvantage but if we take care of these troubles then the benefits we get will last for centuries which will lead to a progressed India. Hence it is necessary to implement the project in accordance with environmental and social values.

References:

- NWDA annual report 2016-2017 (NWDA.gov.in)
- India's River Linking Project: The State of the Debate by Tushaar Shah, Upali Amrasinghe, Peter McCornick. RFF press water policy series.
- Bagla, P. (2006). Controversial Rivers Project Aims to turn India's Fierce Monsoon into a Friend. Main story: Going Against the Flow by Richard Stone and Hawk Jia. Science, Vol. 313, 25 August, 2006. AAAS, Washington D. C., USA
- Autobee, R. 1996. Colorado-Big Thompson Project, United States Bureau of Reclamation (USBR), Denver, Colorado, USA.
- Economic Impact of Interlinking of Rivers Programme, Devendra Kumar Pant and team, National council of applied economic research, 2008.





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

Effects of Sr and Sb on the microstructure, mechanical properties and creep behavior of AZ91 Mg-based alloy

Er. Subrat Kumar Behera

Lecturer In Metallurgy
Osme Keonjhar

ABSTRACT :

The lightweight necessities in the car and transport segments has turned into the essential significance in the current circumstances which has emerged in light of the fact that to diminish the environmental emissions, to expand the effectiveness and to meet the client requests from everyday life for which the powertrain parts requires a need of lightweight with good strength. Magnesium offers different points of interest when contrasted with regular metals like steel, iron because of its **lesser density and offers high specific strength, has better casting properties and great dimensional stability**. Even so, one of the real constraints with the **AZ91 Mg alloy** expansion is the development of the intermetallic $\beta\text{-Mg}_{17}\text{Al}_{12}$, which gives it better room temperature mechanical properties but having the low melting point along the grain boundaries. As the temperature expands over 1200°C , it diminishes and coarsens quickly and decreases the creep resistance of the compound. Henceforth the AZ91 alloy expansion is appropriate for fair temperature extend, however not for the higher temperature run. Therefore, the use of the Mg-Al parallel frameworks in the vehicle business is extremely restricted. The present review is an endeavor to enhance the creep properties of AZ91 alloy through the expansion of alloying components, which frame thermally stable intermetallic, and pins the $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase through the **combined**

addition of antimony (Sb) and Strontium (Sr). All the compounds have been examined for creep at a temperature of 175°C and a stress level of 300 MPa. The impacts of **combined addition of Sr (0.3%) and Sb (0.5%) (wt. %) with AZ91 alloy shows enhance in hardness and creep properties.** Additions of Sr and Sb to AZ91 alloy refined the grains and suppressed the $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase. The improved creep resistance and hardness of the modified alloy i.e. **AZ91-0.5Sb-0.3Sr is due to the reduced fraction of $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase and the presence of thermally stable high melting point intermetallic Mg_3Sb_2 and Al_4Sr phase.**

Key Words: - AZ91 Mg alloy, specific strength, creep resistance, $\beta\text{-Mg}_{17}\text{Al}_{12}$, Mg_3Sb_2 , Al_4Sr

OBJECTIVE :

The objective of the present work is to evaluate the microstructure, hardness, and creep behavior of Mg-9Al-1Zn and Mg-9Al-1Zn-0.5Sb-0.3Sr alloys. The salient objectives of the proposed investigation are as follows:

1. Synthesis of squeeze-cast Mg-9Al-1Zn and Mg-9Al-1Zn-0.5Sb-0.3Sr alloys by squeeze casting.
2. Microstructural characterization of the fabricated alloys by optical microscopy.
3. To investigate the micro hardness of the fabricated alloys.
4. To investigate the impression creep behavior of both the alloys.

EXPERIMENTAL PROCEDURE

Melting and Casting:

Casting of Mg alloys was done using bottom pouring type stir casting furnace that was also equipped with the hydraulic squeezer.

Squeeze casting of Mg-9Al-1Zn alloy:

740 g of Mg-9Al-1Zn die casted ingot was melted in a bottom pouring type stir casting furnace. It was heated up to 750 °C in the presence of the cover gas mixture of SF_6 and Ar. SF_6 and Ar gas was used to create a protective environment in the furnace during casting to stop the oxidization of the melt at high temperature. Cover gas SF_6 and Ar was first mixed in as Ar was flowed at pressure 18 Lb/in² for 50 sec and then SF_6 was flowed at pressure 7 Lb/in² for 3 secs, after that this mixture was used in the furnace as the cover gas. At temperature 750 °C, the stirring of melt was done for 5 minute at RPM 442 after

that pouring was done at temperature 730 °C of the melt. The squeeze casting of Alloy melt was done using a hydraulic press of 40-ton capacity in a steel mould preheated to temperature 220°C.



Fig: -Bottom pouring stir casting furnace with squeeze casting facility

Squeeze casting of Mg-9Al-1Zn-0.5Sb-0.3Sr alloy:

Casting of combined addition Sb, Sr in Mg-alloy was carried out using Master alloy Al+20%Sr and preheated Sb (purity 99.9%) granules. 1.5 wt% Sb was added to achieve target composition of 0.5wt% in the alloy. At temperature 750 p C, the melt was stirred for 5 minute at RPM 442. Stirring was stopped after 5 minutes so that the impurity gets settled in the bottom before pouring. The squeeze casting of Alloy melt was done using a hydraulic press of 40-ton capacity in preheated (220 p C) steel mold.



Fig: - Squeeze Casted Mg-9Al-1Zn-0.5Sb-0.3Sr alloy sample

Microstructural Characterization: -

Initially the samples (15/5 mm rectangular sample) were polished using emery paper of 600, 1000, 1200, 2000 grits. After paper polishing, sample was polished on rotating disc with Beuler proprietary cloth. Polishing was done by holding the specimen gently against the cloth to avoid the scratched as Mg is a very soft material. Diamond paste of $0.25\ \mu\text{m}$ was used on the surface of cloth to get mirror like finish. After polishing, specimens were cleaned in the ultrasonic cleaner using ethanol and dried in air. The specimens were etched using acetic picral (Acetic acid-2.5ml, picric acid-1.5g, ethanol-25ml, distill water-5ml). The optical image was taken using LEICA DFC 295 optical microscope.

Hardness Test :

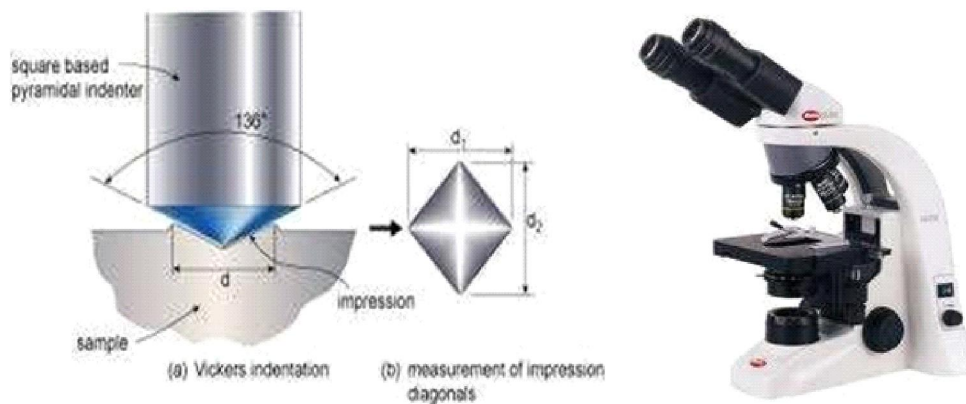


Fig: - Optical microscope

Fig: - (a) Vickers Indentation (Vickers Hardness Test)

(b) Measurement of impression diagonals (Vickers Hardness Test)

The Vickers hardness of the properly polished samples were measured by indentation test, with square base pyramid diamond indenter which under the application of 5kg load with a dwell time of 10sec. Then the diagonals of the indent formed on the material surface (both alloy and composite) were measured then the hardness was calculated based on the following relation

Vickers hardness (HV) = $P/A = 2p \sin(136^\circ/2)/d^2$, which can be approximated by evaluating the sine term to give **(HV) = $1.854p/d^2$**

Where; **A = $d^2/2 \sin(136^\circ/2)$** is the surface area of the resulting indentation in square millimeters, HV is the Vickers hardness, P is the load applied & **d = $(d_1+d_2)/2$** “d1 is diameter of diagonal 1 and d2 is diameter of diagonal 2”

Impression creep test :



Fig: - Impression creep testing machine

The creep test specimen was fabricated from the squeeze casted alloys. The dimension of Sample for the test was formulated in accordance with ASTM E13. Creep tests were performed on squeeze cast specimens using impression creep testing machine.

The impression creep testing setup employed here was provided by Spranktronics Chennai, India. It is a lever based setup (ratio 1:10) and the lever is connected to a pull rod. One cage holding the specimen is attached to the pull rod and another cage holding the indenter is fastened to a fixed base plate. Both cages were kept inside an electrically heated tubular furnace. In this system, a cylindrical shaped indenter made of tungsten carbide was impressed on the specimen and the depth of penetration (h) was recorded as a function of time (t) using a PC based online data acquisition system. The specimens were then cleaned thoroughly by ultrasonic cleaner and dried using hot air blow. The impression creep tests were conducted in the stress value of 300 MPa and temperature of 1750C for a dwell time of 7200 s

RESULTS & DISCUSSION

Optical Micrographs:

Figure (a-b) is representing the optical micrograph of both the squeeze-cast alloys. Optical microstructures showed the distinct presence of dendrites with distribution of second phases in between the dendrites for both the alloys. The refinement in dendritic morphology,

cell size and $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase were observed following the additions of Sb and Sr. The addition of Sb and Sr to the Mg-9Al-1Zn alloy brought about the decreasing in the volume fraction of $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase at grain boundary. Grain refinement because of Sr and Sb could be ascribed to the constitutional super cooling. Sr and Sb give established constitutional super cooling on the solidification front which stops the growth. Grain refining because of the addition of Sb is less obvious than Sr addition for the most part since Sb tends to shape intermetallic.

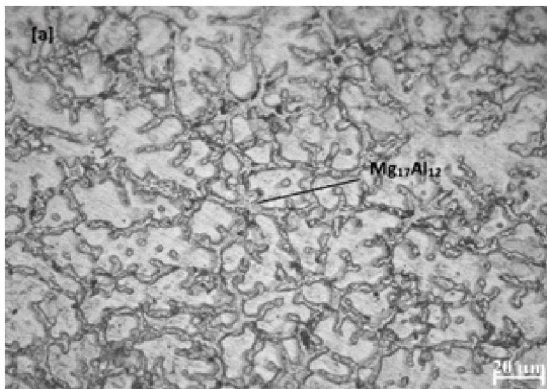


Fig: - (a) (magnification 100X)
Mg-9Al-1Zn alloy

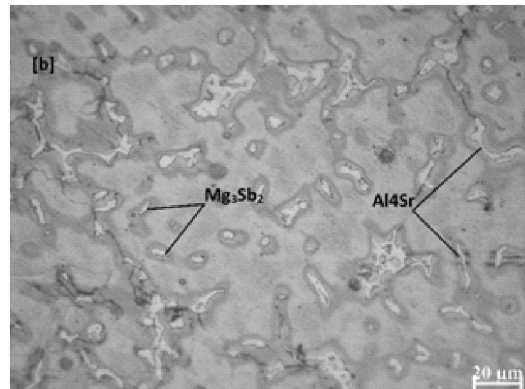


Fig:- (b) (magnification 100x)
Mg-9Al-1Zn-0.5Sb-0.3Sr alloy

Hardness Test :

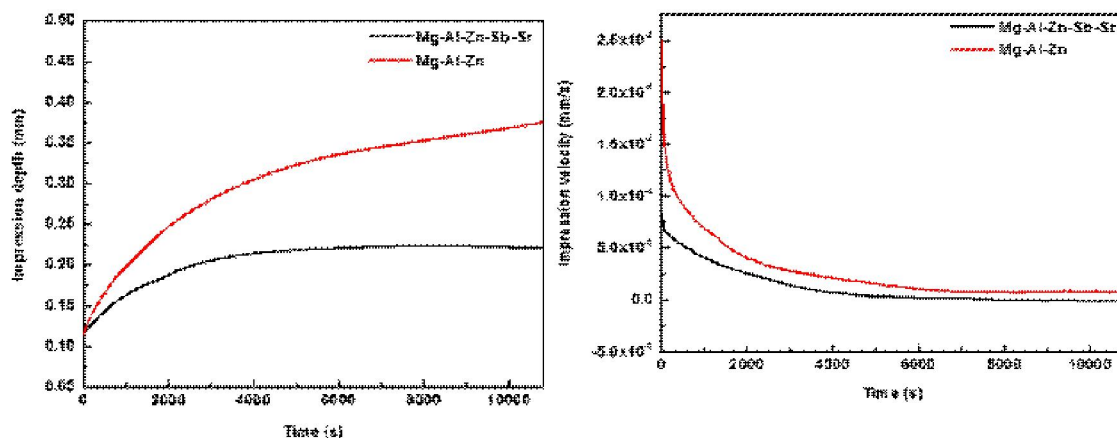
Hardness data obtained are summarized as follows for both of the alloys with load of 50gf and dwell time of 10s.

No. of readings	HV of Mg-9Al-1Zn alloy	HV of Mg-9Al-1Zn-0.5Sb-0.3Sr alloy
1	82.9	116.5
2	79.3	103.1
3	87.1	96.6
4	104.3	109.7
5	88.5	126.8
6	90.3	88.2
7	104.0	113.7
8	81.5	109.0
9	94.4	122.7
10	86.9	121.3

From the above table, it is observed that the Vickers's Hardness Number (HV) of Mg-9Al-1Zn-0.5Sb-0.3Sr is higher than that of Mg-9Al-1Zn alloy due to the presence of intermetallic such as Al_4Sr and Mg_3Sb_2 phases, which act as the reason for increasing hardness of the alloy.

Impression creep test:

The samples were tested at stress level of 300 MPa and temperature 175 °C. Figures demonstrate the creep curve of base Mg-9Al-1Zn and Mg-9Al-1Zn-0.5Sb-0.3Sr alloys. Impression creep curves of both the alloys exhibited well-defined primary and secondary creep stages. There is no indication of tertiary creep owing to the compressive nature of the impression creep test. Low melting $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase in AZ91 alloy gets soften and coarsen with temperature and severely reduces grain boundary strength, resulting in poor creep resistance. The $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase was suppressed by the addition of Sr and Sb with the introduction of thermally stable intermetallic compounds like Al_4Sr , Mg_3Sb_2 phases in microstructure, which improved the creep resistance of the alloy.



CONCLUSION

The impacts of combined addition of Sr and Sb on the microstructure and creep properties of Mg-9Al-1Zn alloy manufactured by squeeze casting were researched. The accompanying conclusions are drawn:

- Additions of Sr (0.3%) and Sb (0.5%) (wt. %) to Mg-9Al-1Zn alloy refined the grains and suppressed the $\beta\text{-Mg}_{17}\text{Al}_{12}$ phase.
- Hardness of Mg-9Al-1Zn-0.5Sb-0.3Sr alloy is higher than AZ91 alloy.
- The modified alloy i.e., Mg-9Al-1Zn-0.5Sb-0.3Sr alloy exhibited superior creep resistance compared to the base Mg-9Al-1Zn alloy.

FUTURE SCOPE OF WORK

The high temperature tensile tests can be conducted on the prepared alloy to know the suitability of the alloys for tensile loading. Alloy with various combination of Sr and Sb can be prepared and tested for microstructure, tensile and creep behavior to optimize the Sr and Sb content in the Mg-9Al-1Zn alloy.

REFERENCES :

- [1] Amberger D., Eisenlohr P., Gokena M., Materials Science and Engineering A 510-511 (2009) 398-402.
- [2] Dieter G.E., Mechanical Metallurgy, Mc Graw Hill, New Delhi 2013.
- [3] Dahle A. K., St John D. H. and Dunlop G. L., Material Science Forum 24 (2000) 159-167.
- [4] Yang Z., Liz J.P., Acta Metallurgica Sinica Science 21 (2008) 313-328.
- [4] Amberger D., Eisenlohr P., Goken M., Material Science and Engineering 510-511 (2009)398-402.
- [5] Amberger D., Eisenlohr P., Gokena M., Materials Science and Engineering A 510-511 (2009) 398-402.
- [6] Franzese O., OAK Ridge National Laboratory (2011). [7] <<http://www.ipcc.ch>> [Last accessed 28 April 2017].
- [7] Nami B., Shabestari S. G., Razari H., Material Science and Engineering A 528 (2011)12611267.
- [8] Magnesium Electron Limited, Magnesium Alloy Database
- [9] Pekgureyuz M.O., Material Science Forum 350-351 (2000) 131-140.
- [10] E.J. Vinarcik, High Integrity Die Casting Processes, John Wiley & Sons, Inc., 2003.[11] Luo Z. D. Song D. Y., Journal of Alloys and Compounds 230 (1995) 109-114.
- [11] Guangyin X., Yangshan S., Material Science Engineering A 308 (2001) 38-44
- [12] Suzuki M., Sato H., Material Science Engineering 252A (1998) 248-255.
- [13] Maruyama K., Suzuki M., Sato H., Metallurgical and Materials Transaction A 33 (2002)875-882.
- [14] Abachi P., Masaudi A., Material Science and Engineering A 435-439 (2006) 653-657.
- [15] Polmear: Proc. Magnesium Alloys and Their Application, B. L. Mordike and HehmanF.,Germany (1992) 201-212.
- [16] Bakke P., Westengen H., Advance Engineering Materials 5 (2003) 879-885.
- [17] M.M. Avedesian, H. Baker, eds., Magnesium and Magnesium Alloys, ASM International, 1999.
- [18] M.O. Pekguleryuz, K.U. Kainer, A.A. Kaya, eds., Fundamentals of Magnesium Alloy Metallurgy, Woodhead Publishing Limited, 2013.
- [19] G.L. Song, A.L. Bowles, D.H. StJohn, Mater. Sci. Eng. A 366 (2004) 74-86.
- [20] P. Labelle, M.O. Pekguleryuz, D. Argo, M. Dierks, T. Sparks, T. Waltmate (2001).
- [21] Qudong W., Wienzhou C., Journal of Material Science 36 (2001) 3035-3040.
- [21] Lin L., Wang F., Yang L, Metallurgical and Materials Transaction A 528 (2011) 1261-1267.





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

Evaluation of e6013 shielded metal arc welding (SMAW) electrode available in indian market

Sagar Kumar Tarai,

*Lecturer In Mechanical Engg,
Govt Polytechnic, Kendrapara*

Abstract :

Evaluation of 5(five) different brands of E6013 Shielded Metal Arc Welding (SMAW) electrodes available in Indian market like ESAB, D&H, MODI, FERROSEAL, ADOR and commonly used in project sites. To complete this project I purchased one packet of E6013 electrodes of above mention brands. Manual arc welding electrode is used extensively (80%) based on cost and availability in various project sites of Odisha. The welding was done using standard parameters i.e. constant heat input. The beads were studied to evaluate the quality of electrodes by observing slag peeling, bead look, welder's appeal etc. The bead dimensions were also measured along with deposition rate.

Keywords: SMAW, E6013 electrode, Slag peeling, Bead look, Welder's appeal, Bead dimensions, Deposition rate

Introduction :

Joining two or more parts to make a single piece is termed as fabrication process. The welding is a metallurgical fusion process used extensively for fabrication. In arc welding the interfaces of the two parts to be joined are brought to a temperature above the melting point and then allowed to solidify, so that a permanent joint is achieved. Because of the permanent nature of the joint and its strength being equal to or sometimes slightly less than the parent metal, welding is one of the most extensively used fabrication method. Welding

is not only used for making structures but also for repair works. The joint obtained by the process of welding are called weld or weldments.

Based on the type the source of heat input, the welding processes can be classified as shown in the Figure below:

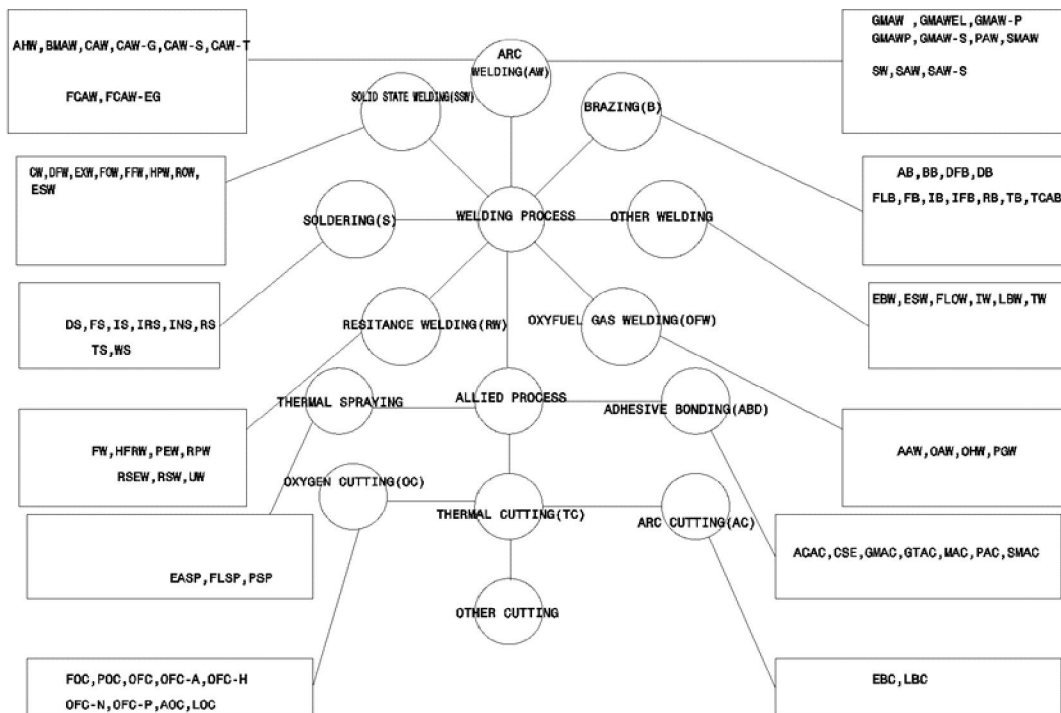


Figure-1

The different types of welding joints are classified as butt, lap, corner, tee and edge joints.

When the thickness increases, it becomes necessary to prepare the edge in such a way that the heat is able to penetrate the entire depth. For thick plates, the welding needs to be done on both sides and to provide the necessary access of the arc into the joint, it is made as a V or U joint.

The V – joint is easier to make but the amount of extra metal to be filled in the joint increases greatly with an increase in the thickness. From this account, a U- joint is preferable, since the amount of extra metal to be added to fill the joint is generally less beyond a certain plate thickness. However, machining a U- joint is difficult compared to a V- joint.

By virtue of metal being melted at the interface of the welded joint, it is necessary that the interfaces are very clean. If the interface are not cleaned, and have any oil, dirt,

paint or grease residue left, then these would interface with the proper fusing of the metal and thus weaken the joint.

To remove the oily substances from the surfaces, organic solvents such as acetone and carbon tetrachloride are used. When organic solvents are used for cleaning, care must be taken to see that solvent is completely evaporated from the interface before any welding is attempted. Otherwise, highly poisonous gases such as phosgene may form from the solvents such as trichloroethylene and carbon tetrachloride under the intense heat of the welding.

Further, the oxide present in the surface would also interfere with proper fusing. Hence, they are to be eliminated by the use of fluxes. A flux is a “material used to prevent, dissolve, or facilitate removal of oxides and other undesirable surface substances” as defined by American Welding Society. The flux is expected to react with the oxides present and form low density slag which would float on top of the molten metal pool protecting it from further oxidation by oxygen in the air. The type of flux used depends on the operation and parent metal that is to be welded.

Another requirement of welding is a filler metal. Except for resistance welding process, all other processes require a filler metal to fill the gap between the parts to be joined. The composition of the filler metal ideally should be same as that of the base metal which is to be joined. It is also possible to use additional alloying elements to strengthen the joint.

The following are definition of some of the welding terms that are generally used:

BEAD: It is the metal added during a single pass of welding. The bead appears as a separate material from the base metal.

DEPOSITION RATE: The rate at which the weld metal is deposited per unit time is the deposition rate and is normally expressed as kg / hr.

PENETRATION: It is the depth up to which the weld metal combines with the base metal as measured from the top surface of the joint.

WELD PUDDLE: The portion of the weld joint that is melted by the heat of welding is called puddle.

BACKING: It is the material support provided at the root side of a weld to aid in the control of penetration.

CRATER: In arc welding, a crater is a depression in the weld metal pool at the point where the arc strikes the base metal plate.

To strike the electric arc, the electrode is brought into contact with the work piece by a light touch with the electrode to the base metal then is pulled back slightly. This initiates the arc. The consumable electrode causes droplets of molten core wire to pass from the electrode to the weld pool. As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, it must be chipped away to reveal the finished weld. As welding progresses and the electrode melts, the welder must periodically stop welding to remove the remaining electrode stub and insert a new electrode into the electrode holder. This activity, combined with chipping away the slag, reduce the amount of time that the welder can spend laying the weld making SMAW one of the least efficient welding processes. In general, the operator factor, or the percentage of operator's time spent laying weld, is approximately 25%.

The actual welding technique utilized depends on the electrode, the composition of the work piece, and the position of the joint being welded. The choice of electrode and welding position also determine the welding speed. Flat welds require the least operators skill, and can be done with electrodes that melt quickly but solidify slowly. This permits higher welding speeds. Sloped, vertical or upside-down welding requires more operator skill, and often necessitates the use of an electrode that solidifies quickly to prevent the molten metal from flowing out of the weld pool. However, this generally means that the electrode melts less quickly, thus increasing the time required to lay the weld.[2], [3]

POSITION OF WELDING:

Ideally, the work should be positioned during the welding, so that the molten weld metal is held in place by gravity. It also enables high currents to be used, leading to faster welding. This implies that the work can be turned. Many fabrications do not lend themselves to this treatment, and much of the welding in industry is done "in position". The welder controls the weld by lowering the heat input to reduce the fluidity and to give a small pool which solidifies before it has time to run out of the joint. At the same time the direction of the arc, i.e. the angle between the electrode and the weld surface, can be varied to the position the weld pool to the best advantage.

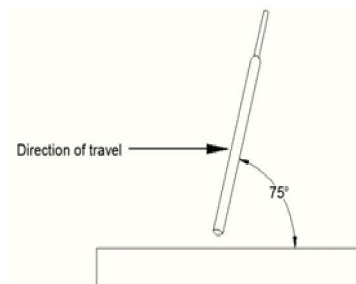


Figure -.4
(SUITABLE ANGLE FOR FLAT
WELDING FOR SMAW)

CHAPTER – 4

PARAMETERS FOR ARC WELDING:

When start the welding operation, there are a few parameters that must be set up to make sure that the welding process can be easily operated smoothly. The parameters that must be set up are often selected for welding thin metals. Most covered electrodes operate best with electrode positive (reversepolarity), which produces the deepest penetration. Electrode negative operation might produce a higher melting rate. The secondary variables include the angle of the electrode to the work, the angle of work itself, the thickness of the flux layer and the arc length.

TRAVEL SPEED:

The speed of electrode travels along the joint has a direct influence on the bead shape, depth of fusion, cosmetic appearance and heat input to the base metal. Faster travel speed produce narrow bead that have less penetration. This can be advantages for sheet metal welding where small bead and minimum penetration are required. Travel speeds also affect heat input, which in turn influence the metallurgical structure of the weld metal. The cooling rate increases or decreases proportionately with the travel speed. Also, the heat affected zone will increase in the size and the cooling rate decreases. If the speeds are too fast, however, there is a tendency for undercut and porosity, since the weld freezes quicker.

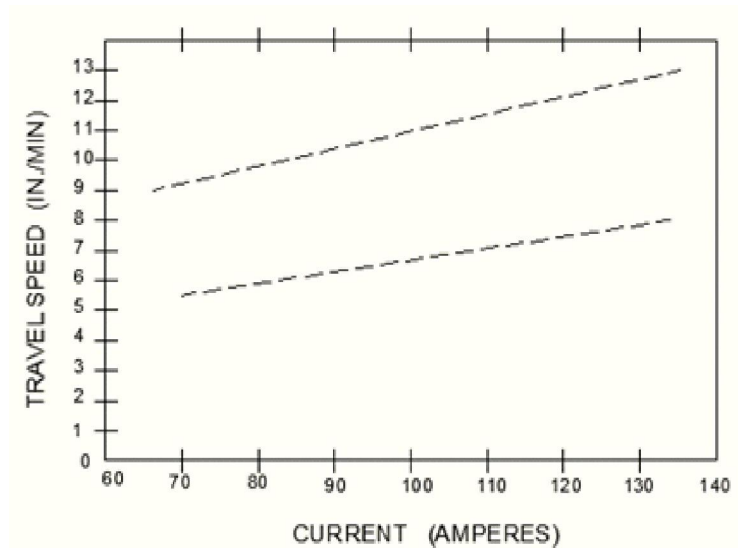


Figure-5 Travel Speed Vrs.Current (E6011 SMAW electrode)

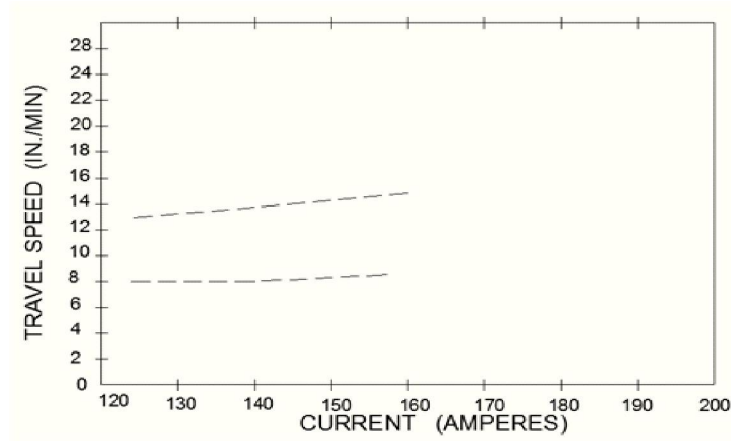


Figure-6 Travel speed Vrs Current (E6013 SMAW electrode)

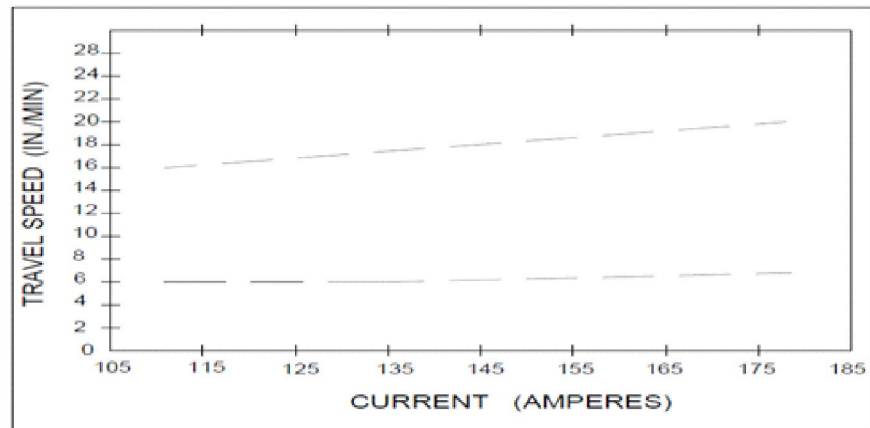


Figure-7 Travel speed Vrs Current (E7018 SMAW electrode)

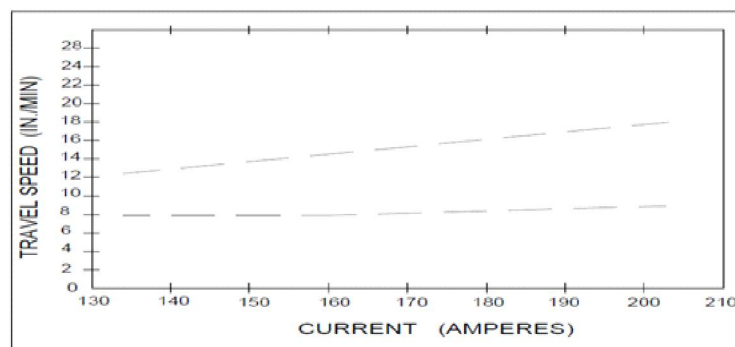


Figure-8 Travel speed for current level used E7024 SMAW electrode

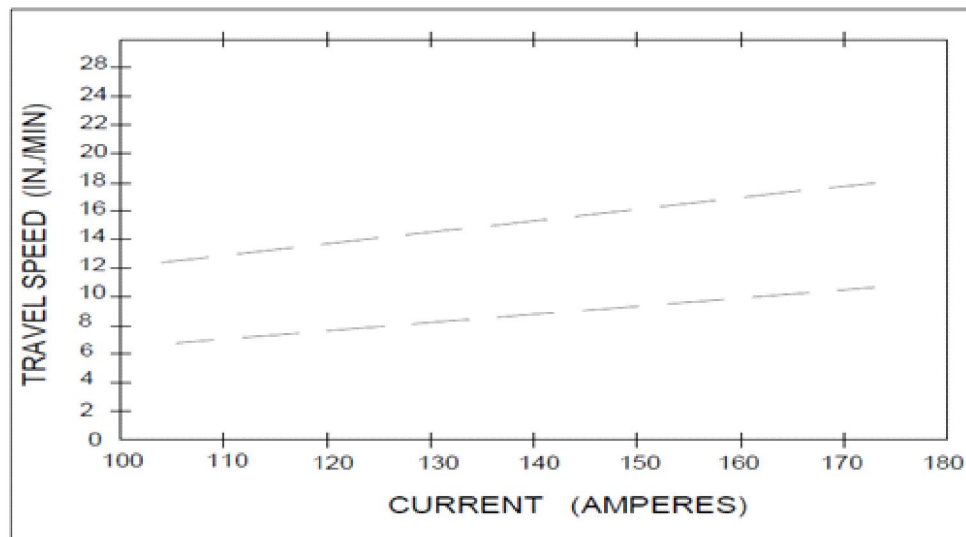


Figure-9 Travel speed for current level E8018 SMAW electrode

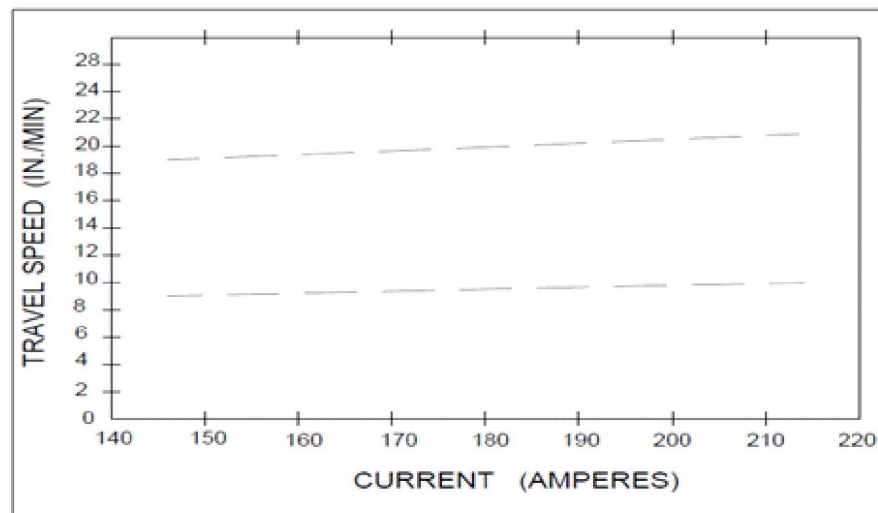


Figure-10 Travel speed for current level E11018 SMAW electrode

AMPERAGE:

How to determine the correct amperage for a certain electrode will depend on the size and classification of electrode. Even the type of joint and welding position must be considered. The process requires sufficient current to melt both electrode and the base metal. The higher the current can cause deeper penetration. Using too high amperage may cause problems, such as, excessive spatter, electrode overheating and cracking.

Welding current level is determined by the size of electrode - the normal operating range and current are recommended by manufacturers. As a rule of thumb when selecting a suitable current level, an electrode will require about 40 amp / millimeter (diameter). Therefore, the preferred current level for a 4mm diameter electrode will be 160 A, but the acceptable operating range is 140-180.

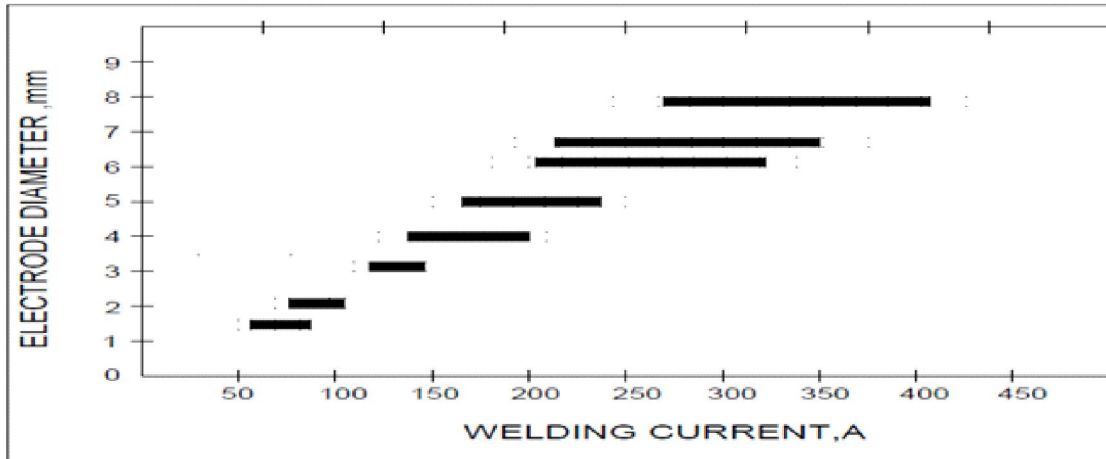


Figure-11

ARC VOLTAGE:

The arc voltage is varied within narrower limits than the welding current. It has an influence on the bead width and shape. Higher voltages will cause the bead to be wider and flatter. Extremely high arc voltage should be avoided, since it can cause cracking. The low arc voltage produces a stiffer arc that improves penetrations. If the voltage is too low, a very narrow bead will result.[4], [5]

ELECTRODE	VOLTAGE LIMIT, V
E6010	28-32
E6011	28-32
E6013	22-26
E7018	25-28
E7024	26-32
E8018	22-28
E11018	25-30

HEAT INPUT :

Speed of welding is defined as the rate of travel of the electrode along the seam or the rate of travel of the work under the electrode along the seam

Speed of welding = Travel of electrode mm/min.

Heat input rate or arc energy = $V \times I \times 60/S$ Joules/mm

Where,

V is arc voltage in volts,

I is welding current in ampere,

S is speed of welding in mm/min.

CHAPTER – 5

EXPERIMENT :

In the construction sites of Odisha various types of E6013 electrodes are used. I only selected 5(five) brand varieties of E6013 electrodes which are popular in the construction sites. The electrodes are manufactured by companies and brand like "ESAB-Ferrokings, MODI-Steelcon Standard, FERROSEAL, D&H-Econotherme, ADOR-Superbond". A mild steel plate of 220 X 95mm was selected for experimental beads using standard parameters mentioned in TABLE: 2 below. An ESAB welding machine model RS -400, $3X415 \pm 10\%$, 50Hz was selected to conduct the experiment.



Figure – 12

STANDARD WELDING PARAMETERS:

SL. NO	CURRENT (ampere)	VOLTAGE (volts)	Bead Length	Time (Seconds)	SPEED mm/min	HEAT INPUT (J/mm)
1.	150	22-24	95mm	41-42	135.71	1459

TABLE : 2

The experimental beads were laid in the plates with using standard parameters. All together 5 (five) beads were laid.



Figure-13

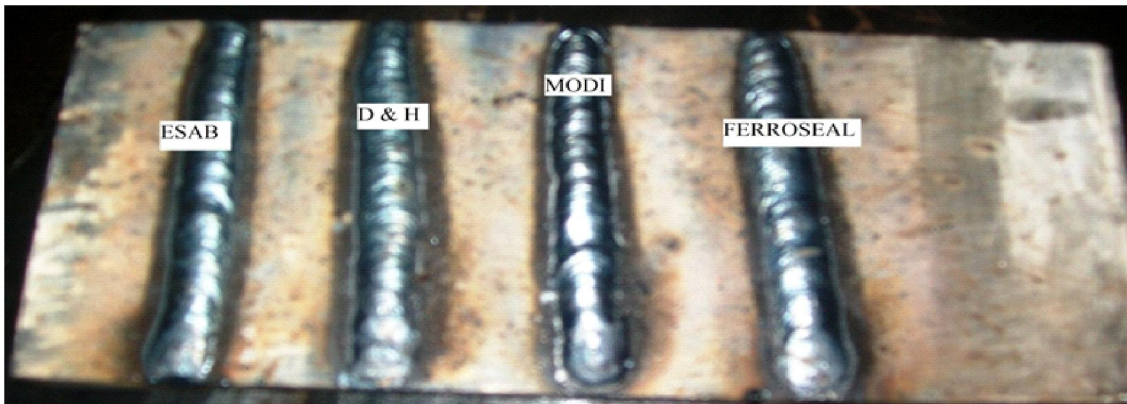


Figure-14

CHAPTER – 6

OBSERVATION:

Weight of work piece before welding bead formation=1.600kg

After 1st bead formation weight=1.650kg

After 2nd bead formation weight=1.700kg

After 3rd bead formation weight=1.750kg

After 4th bead formation weight=1.800kg

After 5th bead formation weight=1.850kg

BRAND NAME	
ESAB	Fewer Spatters, More Noise, Good Fusion, Crater Defect
MODI	Less Spatter, Medium Noise, Good Fusion, Weld look is very good (Shiny Bead), No Defect
FERROSEAL	More Spatter, More Noise, Under cut defect, Crater defect, Fusion is ok
D&H	Less Spatter, Less Noise, Fusion is not very well, Undercut defect
ADOR	Less Spatter, Smooth Noise, Good Fusion, Uniform feed, Undercut defect

TABLE : 3

BRAND NAME	Slag Peeling	Bead Look	Welder's Appeal	Score #	Deposition grams	No of Electrode*	Cost (Rs.)	Cost/pc Rs.
ESAB	B	C	B	11	50	85	590	6.94
MODI	A	A	A	15	50	100	956	9.56
FERROSEAL	C	B	C	10	50	60	350	5.83
D&H	D	D	D	06	50	80	630	7.87
ADOR	O	O	O	18	50	90(5Kg)	1090	12.11

*Per Packet

Out Standing (6) A: Very Good (5) B: Good (4) C: Satisfactory (3) D: OK (2)

TABLE : 4

By adding a new brand of electrode i.e. ADOR to the existing brands (ESAB, D&H, MODI, FERROSEAL) the different parameters are studied are describe in the table as shown below :

BRAND NAME	WEIGHT OF ELECTRODE (in grams)	WEIGHT OF CORE WIRE (in grams)	WEIGHT OF FLUX (in grams)	COATED ELECTRODE Diameter in mm
ADOR	56.70	43.76	11.21	5.0
D&H	54.68	43.60	10.29	5.1
FERROSEAL	58.70	43.42	14.22	5.1
ESAB	54.62	43.35	9.51	5.1
MODI	57.18	44.03	12.03	5.09

TABLE : 5

N.B:

Calculation procedure for penetration

$(x+y)/2$ where x & y are the penetration rate at both ends of the plate.

Calculation procedure for bead height

$(x+y)/2$ where x & y are the height of the bead at both ends of the plate.

Calculation procedure for bead width

The given bead on the plate is subdivided into 5 subparts and the averages of 5 subparts are taken into account.

BRAND NAME	PENETRATION mm	BEAD HEIGHT mm	BEAD WIDTH mm
ADOR	$(2+1.5)/2=1.75$	$(3.4+3.5)/2=3.45$	$(1.1+1.05+1.12+1.2+1.18)/5=1.13$
D&H	$(1.5+1.5)/2=1.5$	$(3+2.8)/2=2.9$	$(1.05+1.15+1.2+1.2+1.1)/5=1.14$
FERROSEAL	$(1.5+1.5)/2=1.5$	$(3.5+2.5)/2=3$	$(1.05+1.1+1.08+1.15+1.18)/5=1.11$
ESAB	$(1.5+1.5)/2=1.5$	$(3.5+2.8)/2=3.15$	$(1+1.1+1.1+1.12+1.2)/5=1.10$
MODI	$(1+2)/2=1.5$	$(3.5+2.5)/2=3$	$(1.02+1.15+1.15+1.2+1.18)/5=1.14$

TABLE: 6



Figure.15

CONCLUSIONS :

1. It was observed that all the brands are giving almost equal deposition rates of 50gm/ electrode.
2. The bead height was varying from 2.9mm to 3.45mm& bead width varying from 1.10mm to 1.14mm for all brands.
3. The prices of ADOR WELDING LIMITED, SUPER BOND electrode is the highest/ piece Rs.12.11&FERROSEAL is lowest/piece Rs.5.83.
4. The penetration of ADOR WELDING LIMITED, SUPER BOND electrode is the highest i.e. 1.75mm and all other brands gave a penetration of 1.5mm approx.
5. ADOR WELDING LIMITED, SUPER BOND performance was the best with a score of 18 (Eighteen) - slag peeling & bead look, welder's appeal.

REFERENCES:

- [1] Rao, P.N. Manufacturing Technology, Vol-1, 3rd Edition 2009, Chapter-9, Tata McGraw-Hill, P-342-346.
- [2] Basic Welding Filler Metal Technology, www.esabna.com/, EuWeb/AWTC/Lesson-I & Lesson III
- [3] Zakaria, Bin, Azizulhakim, Nur, Development of welding aid kit for SMAW, May 2007
- [4] Little, L, Richard, 37th Reprint 2009, Welding and welding Technology, P- No.201-202
- [5] Shielded metal arc welding (SMAW), www.metalnews.net





Journal of Polytechnics by Odisha Govt. Polytechnic Teachers' Association

Website: www.ogpta.org.in (Volume 1, Issue 1, January 2020), Communication:
ogpta.journal@gmail.com

Investigation of Electrical Transport Property in Spinel NiCr_2O_4

S. N. Tripathy¹, Abhipsa Pati², K. L. Routray¹, and D. Behera^{1*}

*¹Department of Physics and Astronomy, National Institute of Technology,
Rourkela-769008, Odisha, India.*

*²Department of Physics, College of Engineering and Technology
Bhubaneswar-751003, Odisha, India.*

**E-mail: dbehera@nitrkl.ac.in*

Abstract :

In the present work, we have discussed the electrical transport properties of the polycrystalline NiCr_2O_4 by employing Impedance spectroscopy and DC resistivity techniques. It was observed that charge carriers follow Arrhenius type conduction throughout the temperature range. Activation energy (E_a) has been calculated from the impedance data, 0.462 for Rgb and 0.42 from Rg, which is well buttressed by the activation energy from the DC resistivity fitted data which is 0.468 eV.

Keywords: Multiferroic, Variable range hopping, Hopping Transport

PACS: 75.85, +t, 72.20, Ee, 72.20, jv

INTRODUCTION :

Recently chromite spinels, ACr_2O_4 (A = Ni, Co, Fe, Mn) have been extensively studied for their multifunctionality and rich underlying Physics. These system have been well reported for their multiferroicity and significant spin lattice coupling in the low temperature regime below 100 K [1, 2]. Apart from the strong underlying physics, their applicability as sensors, spintronics, catalysts etc. conceives a lot of attention to study them. Among these spinels, NiCr_2O_4 (NCO) is a strong candidate, owing to the presence of its multiferroicity as well as magnetodielectricity [2]. NCO crystalizes in cubic structure with space group ' $I41/amd$ ' having normal spinel structure and bearing ferrimagnetic transition temperature

$TC \approx 80$ K [2]. However, electrical transport behavior of this system has been sparsely studied. As we know Impedance spectroscopy and DC resistivity are the powerful technique for providing essential information regarding the conduction of charge carriers inside the material so we are ensuing the same technique in order to explore the physics behind the conduction in our system under investigation [3, 4].

In the present study, we have mainly focused on the transport behavior of charge carriers in the temperature range 30-200 0C. From both DC resistivity and impedance analysis, it is revealed that the charge carriers follow nearest neighbor hopping (NNH) type conduction throughout the measured temperature range.

EXPERIMENTAL TECHNIQUES

Polycrystalline $NiCr_2O_4$ system was prepared by standard solid state reaction method [1]. The crystal structure and phase identification was determined by the by RIGAKU X-Ray Diffractometer at room temperature using Cu $K\alpha$ radiation. Temperature dependent AC impedance in the frequency window of 100Hz-1MHz was measured by HIOKI-IM 3570 Impedance analyzer and DC resistivity measurements were done by the help of KEITHLEY 6517B Electrometer in the temperature range 30-2000 C.

RESULTS AND DISCUSSION

Fig.1 shows the X-ray diffraction spectra of NCO at room temperature. All the peaks present in the XRD pattern belong to the cubic structure and no secondary peaks are observed which confirms the formation of single phase of NCO (JCPDS 896615) system. Inset figure shows the FESEM image of NCO having non uniform grains with average size ~ 2 μm .

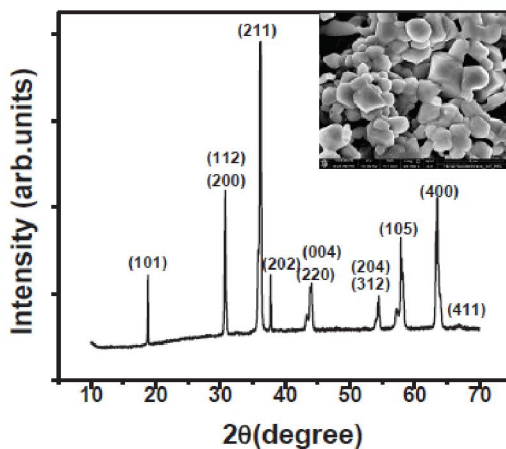


FIGURE 1: XRD pattern of $NiCr_2O_4$ and inset shows FESEM at room temperature.

Table 1. Derived parameters for grain and grain boundary at varying temperature

Parameters	30°C	60°C	90°C	120°C	150°C	180°C	200°C
		29450	5787	2138	1338	994	742.6
R _{gb} (Ohm)	702000	180200	53220	16640	5721	1814	846.3
ng	0.7011	0.5709	0.8053	0.3124	0.1011	0.1855	0.2011
ngb	0.8027	0.8281	0.8097	0.8294	0.8662	0.9383	0.9663

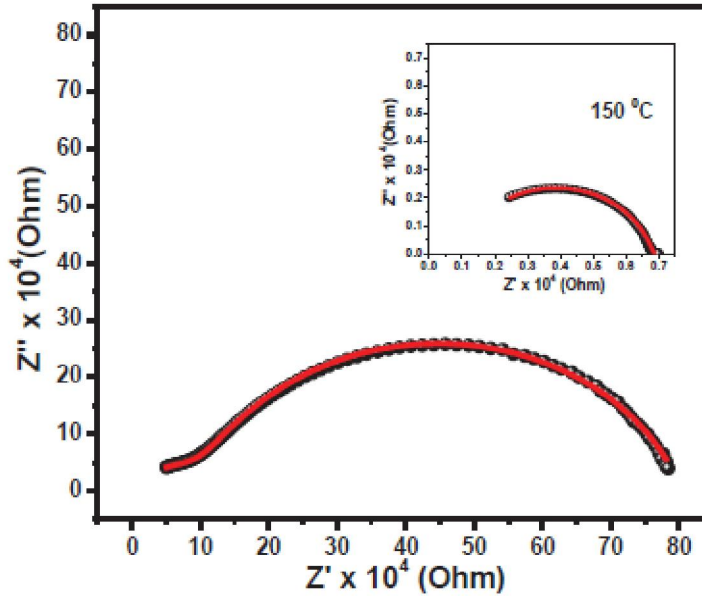


FIGURE - 2

Nyquist plot at 30 °C and 200 °C (inset) along with an equivalent circuit to fit the data

Figure 2 shows the Nyquist plot of NCO at 30 °C and 150 °C (inset). In order to get further understanding of the experimental findings, an equivalent circuit model (RQ-RQ) was implemented using ZSimpWin version 2.0. Software. The derived parameters are shown in table 1. The resistance values obtained from the fitting may be assigned to the grain and grain boundary respectively [8]. As we are mainly focusing on the charge carrier conduction, we were more interested in the obtained resistance values and their variation with temperature.

As we know there are various hopping models being proposed such as: (a) NNH where electrons or charge carriers hop between nearest neighbors having activation or hopping energy (E_a), which is given by the equation [3]:

$$\rho = \rho_0 \exp\left(\frac{Ea}{K_B T}\right)$$

- (b) if the electron do not have enough energy to hop between neighbors it will hop to the distant states following Mott VRH conduction [3,5] given $\rho = \rho_0 \exp\left(\frac{T_0}{T}\right)^{1/4}$ where,

T_0 is the Mott temperature [6]. We have tried to fit our data with the above mentioned models and found that, Arrhenius type or NNH model fits well to our obtained data.

Figure 3(a) and 3(b) shows the plot between $\ln R_1$ and $\ln R_2$ with inverse of temperature. In order to go in more detail, we fitted these data with Arrhenius type conduction model and it is found to be well fitted.

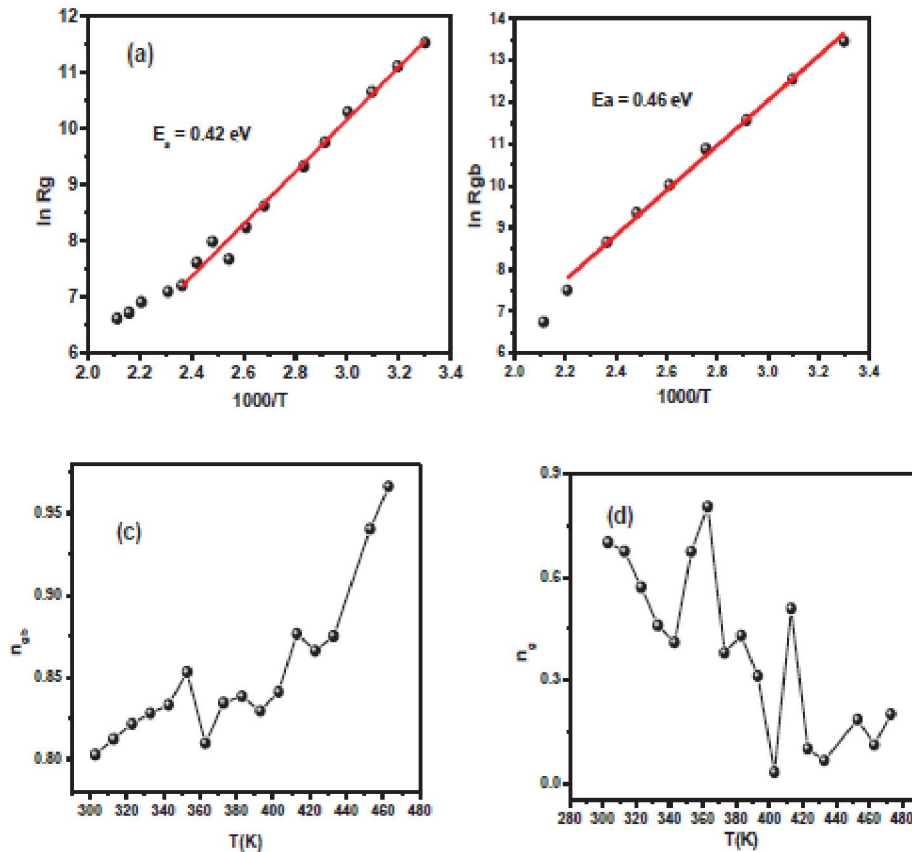


FIGURE – 3

(a) and (b) shows the fitting of R_1 and R_2 and (c) and (d) shows the variation of n_g , n_{gb} with temperature respectively.

The activation energy values are being obtained, as 0.42 and 0.46 eV respectively for grain (R_1) and grain boundaries (R_2). The parameter n_{gb} and n_g obtained has been plotted against temperature in Figure 3(c) and (d). in the case of n_{gb} , it is showing an increasing trend from 0.8 to 0.98 in the measured temperature range, approaching unity likely to be an ideal behavior while in the other case for n_g , it shows a reverse trend which is happens to be deviated from the ideal behavior [8].

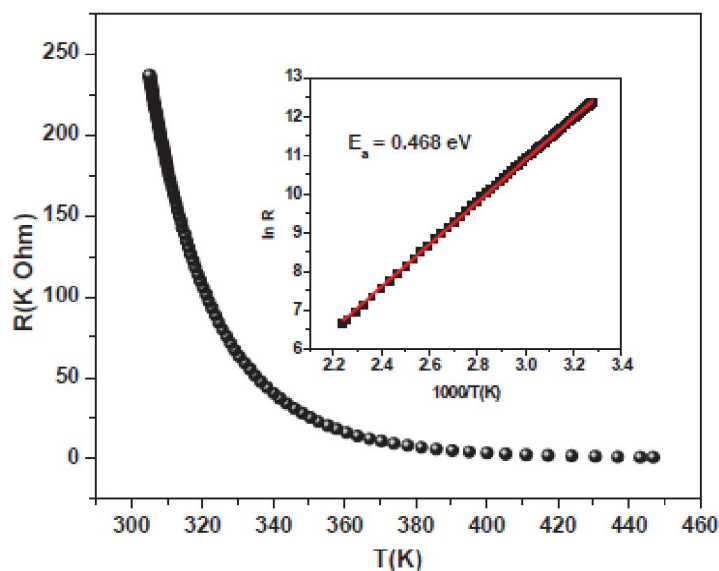


FIGURE – 4

Graph showing variation of R with T . inset shows graph of $\ln R$ Vs $1000/T$.

Solid red lines are are straight line fitting.

Figure 4 shows the variation of DC resistance with temperature, which shows the semiconducting nature of the system. For further understanding i.e. to know the exact conduction mechanism these data is being fitted to Arrhenius equation which gives a well fit and the activation energy found to be 0.468 eV. So the data from the fitting of DC resistance provides an essential evidence of the mechanism of conduction in our system under investigation.

Conclusion :

We have successfully prepared the polycrystalline NCO having average grain size approximately equal to 2 μm . The type of conduction mechanism of the charge carriers were analyzed from both DC resistivity and AC impedance measurement n the temperature

regime 30-200° C. From our analysis, it was found that throughout the measured temperature range the conduction mechanism is purely Arrhenius type which is well strengthened by both the data.

ACKNOWLEDGMENTS :

We would like to acknowledge IUAC New Delhi for funding. SNT would like to thank A. K. Biswal, S.R. Mohapatra and R. Pattnayak for their valuable suggestions.

REFERENCES

1. N Mufti et.al *J. Phys.: Condens. Matter* **22**, 075902 (2010).
2. Taylor D. Sparks et.al *Phys.Rev.B* **89**, 024405 (2014).
3. A. K. Biswal et.al *J. Appl. Phys.* **115**, 194106 (2014).
4. R. K. Panda et.al *J. Alloys Comp.* **615**, 899 (2014).
5. P. N. Vishwakarma et.al *J. Appl. Phys.* **100**, 113702, (2006).
6. Wasi Khan et.al *J. Chem. Phys.* **135**, 054501 (2011).
7. R. Schmidt et.al *Phys.Rev.B* **72**, 115101 (2005).
8. M Idrees et.al *J. Phys. D: Appl. Phys.* **43**, 155401 (2010).



ABANDONED

A. N. Arpita Aparajita

Lecturer in Physics

Govt. Polytechnic, Bhadra

This is the world of hers- a compounded room, some medicines, a bed and bedpan, some utensils and cloths of use. Years or so, she is lying on this bed as if an obsolete element of no further use-putrid her existence seemed to her. The room is defiled, a foreboding loneliness radiating from the four walls around her, sounds of world no more a visible sign -her pungent loneliness gets merged with the depressing wind of room when a deep sigh of despair comes out rending her heart but she knows that is not even a sign of relief, her heart like a locked cage from every side...

Everyday a duty bound - her daughter - in - law comes twice or thrice to the room to feed her without even having a slight attention or due care pinned to her attitude. She has become useless, the geography of human mind has also no place for her she only curses her self. Helpless she is lying on the bed, paralyzed at her whole body, a thought sways her mind - for the moment if at least she could be able to shake her hands to take the foodstuffs of her own...she won't have to depend on her daughter in- law for that, but dreaded destiny, nothing happens like that other than the food grains getting drenched with soaked tears of her-the tears that nobody sees or may be does not intend to see. She only recapitulates, memory gets back to years ago, the reflections of past tip-toes at her mind through the unseen tears and she plunges in her own thoughts...

Time rambles on her memory, she is in the flashback of life-

Years ago, when this paralyzed hand of hers fought alone to make her two year old son to stand on his own feet against adversaries and threats faced by her from a cruel and intolerant world, she was experiencing - it is not always a smooth world to live by. It was just three years to her marriage when her husband passed away only to leave her all alone to face the world. She did not lose her patience; she came out with self confidence, her trust always standing as a support to her. It was not possible for her to manage to get a stable job in Govt. or corporate sector due to her marginal qualification status, but the little

belongings what her husband left for her inform of landed properties was now directly demanding attention of her. She surged her will power leaving aside the tradition of house wife to remain at home, kept her foot outside, struggled hard to walk shoulder to shoulder, to be one of them who toils their life with land, soil and water. Her son was everything to her, she resolved to give him education, she gave him protection of father - she gave him abundant affection of mother. And her hard labour did not go in vain. God rewarded her honesty and labour and her son got a suitable Govt. job after graduating from a reputed university. It seemed the shadows of black clouds are now drifted away, time showering its blessings. In due course of time she got her son married and a beautiful bride came to her home to make it more beautiful, more fulfilled. All was running smooth in the stride of luck, she poured all her affection to the daughter-in law in a feeling of her own daughter and in return she was also getting her due respect and motherly belongingness. At this juncture she was remembering her husband, if he also would be there...life is not only that what is visibly seen.

Time was passing as if there are no more hurdles in life, but who knows what destiny is ! No one understands due to what evil deeds of her inprevious births her active body got paralyzed one odd morning ! His son and daughter-in-law did their level best, doctors were trying to their best capacity, but men poses God disposes, nothing seemed to do well when day by day her condition got worsened and she was left with no other option but to lie down on bed for rest of her life time.

It was pain in her physical body, but his son and daughter - in - law were taking due care of her, relatives were there who on their own came frequently to give company, to sit by side of her and talking in asharing way.

But who can calculate what lies for us in hidden ! Probably it does not take long when the whole scene gets changed. How much one can do ! Now a days' no one comes to her, if occasionally some turn up, time reminds them immediately after 10 minutes some of their important house hold jobs as if the jobs would remainin complete for ever if they don't go and they leave hurriedly. She only now does not have any job ... tears of remorse came down insistently from both her eyes, but it is own fate, she does not blame any body. She has seen the world in her owneyes, probably there is more God wants to see her.

The affection and attention of daughter - in - law is no more there, are markable shift in her attitude has become prominent. Her mind clogged, she was contemplating trying to remember when for the last time she was acclaimed with an affectionate touch from her !

Now in her crisis, sometimes she is left with only adried throat when she needs a glass of water, her asking goes unnoticed, how much ignored she is...but what can she do !

Before a couple of days she accidentally overheard her daughter - in - law saying a neighbour - “how long will this sinner stay in the earth to suffer herself and to dragg me along side her, I would be in peace if this devil would leave me soon-”

She was bleeding deep inside with such words, but does she herself want to live with all these pains and negligence ! Does she not see how unbearable the situation for her ! She bled more when again she remembered she does not even possess the strength to kill her self.

In the cloud of her thoughts she was asking - is it death also like others that has abandoned her.



KILL ME

Tushar Das Pattnaik

Lecturer in Metallurgy

OSME, Keonjhar

My name is 'copy' and i am not the culprit, I increase pass percentage of the institution, I am a dear friend to all unethical students during exam. After exam nobody cares for me. I am nothing without students and they are nothing without me as well. My script comes from variety of good books and when it stays under the light of Xerox machine, I born on this earth. Society sells me cheaply. I see a lot of new faces before the day of exam. I feel happy as I am able to help them in exam at the same time I feel sad as I am forcing my nation to go backward.

I am a 'micro Xerox' and I am not the miscreant. I live for maximum of 3 hrs. I travel from one person to other so fast. People hide me in such places that even i feel ashamed and the smell...,yuk... I feel like a prostitute without physicality. After short span of my living, the selfish people twist and tear me apart and throws me into my grave yard i.e. dustbin. The "use me" written on dustbin smiles at me sarcastically and gets used maximum on that day filled with myself and all my brothers.

I am a chit and I am not the perpetrator. The nation's result and hence our education minister and secretaries chair mostly depend on me. If I die, the nation wilt see the calamity of failure of students. The whole system tries to kill me superficially. I live happily under the shadow of rupees and power. I create thunder in the whole system. A decade ago, I was being written by students personally and I had some value; but, today I am a mere use and throw pen. I hate this Xerox machine,

A kind hearted writer closed my eyes and took me for a world ride. When I opened my eyes I realized, Am I seriously helping my nation ?? No.

My name is 'copy' and I am the culprit, if I stay, i will make my nation disabled. But, if I live, I will definitely kill rny nation, I wanna die...kilt me.....



TINYTALES

Arpita Aparajita

*Lecturer in Physics
Govt. Polytechnic, Bhadrak*

1. BURDEN

She held the umbrella more tightly and continued to walk. It started to pour even heavier.

The merciless wind chose to ally with the spurting anger.

She stood still, took a deep breath.

Threw the UMBRELLA and rushed towards her destination.

2. COMPASSION

Hey! The pace of rain has decreased. She wiped her face using both her hands.

The paths were clearer. She smiled and continued.

A constant murmur drew her attention, at the end of which were the innocent eyes
belonging to a snowy soft puppy.

With her untouched smile, she lifted and wrapped the puppy with all her WARMTH.

3. BRIGHTNESS

She pushed the door wide open.

She is amazed. At her back - a damp evening, in front - a welcoming LIGHT.



EDUCATION

Subhasmita Nayak

Lecturer In Civil Engg.

Govt. Polytechnic Mayurbhanj

Education is a process, which never ends,
That always grows, but never fades.
The name of the way to get success is education,
Which is the combined effect of surrounding inspiration.
The another form of education is learn,
What you learn, is converted into what you earn.
It is the summation of motivation and explanation,
From which we take part in any competition.
As a result of this, we become more effective,
And this makes us more and more creative.
From the birth to the death, take the process,
Follow the path, utilize the way and get the success.
History says this is the track to live the life,
So gain your knowledge with proper shape and size.
Before you build a house, you do the foundation,
Like that before you grow up be a part of education.



ବହି ବିଦ୍ରୋହ

Tushar Das Pattnaik

Lecturer in Metallurgy

OSME, Keonjhar

ନା ଆଜି ପଢ଼ିବିନି । ତାଲୁନୁ ଯିବା ବାଲିଯାତ୍ରା ବୁଲିବାକୁ । ଭାରି ତ ମନ । ଅଣ୍ଟାରେ ଖୁଁ ଖୁଁ ହଉଛି । ଶୀତ ଯେଉଁ ପଡ଼ିଛି କହିଲା କଣ ନା ବାଲିଯାତ୍ରା ଯିବି । ପଢ଼ ବସିକି । ପରାକ୍ଷରେ କ’ଣ ପଢ଼ିବ ବାଲିଯାତ୍ରାର ଆତ୍ମକାହାଣୀ ଲେଖିବୁ । ଏମିତି ମୁଁ ଆଉ ମୋ ମନ ସଦାବେଳେ ଛକାପଞ୍ଚାରେ ଲାଗିଥାଉ । କେତେବେଳେ ମୁଁ ଖୁସି କରାଏ ତାକୁ ତ ସିଏ କେତେବେଳେ ମୋତେ । ମନ ଦୁଃଖ ଥିଲେ ମୁଁ ତାକୁ ବୁଝାଏ, ମୁଁ ଦୁଃଖୀ ଥିଲେ ସିଏ ମୋତେ । ଏମିତି ସ୍ନେହାର ଆଦାନ ପ୍ରଦାନକୁ ଖଟା ମନ ଦେଖୁଥାଏ “ଆମ ବହି” । ଜାଣତରେ ହଉ ବା ଅଜାଣତରେ ହଉ ଆମ ଜୀବନରେ ସିଏ କେବେ ନ କେବେ ସାଙ୍ଗ ହେଉଛି । ଆମେ ଆଜି ଯେଉଁଠି ପହଞ୍ଚିଛୁ ଆମ ବହିର ସହାୟତାରେ । ବହି ବି ଆମମାନଙ୍କ ପରି ମଣିଷଟିଏ । ଆମେ କଲା ବା ଗୋରା ବା ଶ୍ୟାମଳ ହେଇଥାଉ । ସେ କିନ୍ତୁ ରଙ୍ଗ ରଙ୍ଗୀ । ଆମ ଦେହରେ ରକ୍ତ ତା ଦେହରେ ଜ୍ଞାନ । ଆମର ନାଁ ଯେମିତି ଅଛି ତାର ବି ସେମିତି ନାଁ ଅଛି । ତାର ପ୍ରଥମ ଫର୍ଦ୍ଦରୁ ଶେଷ ଫର୍ଦ୍ଦ ମୁଣ୍ଡରୁ ଗୋଡ଼ ଯାଏ । ଆଲୋକ ହିଁ ତାର ପାଇଁ ଅମୃତଜାନ । ଅନ୍ଧକାର ତାର ଶତ୍ରୁ । ହେଲେ ସେ କଥା କହିପାରେନା । ଯାହା ବି କୁହେ ଆମ ପାଟି ସାହାଯ୍ୟରେ । ଯଦି କତା କହିପାରନ୍ତା, ଯଦି ସେ ଚାଲିପାରନ୍ତା, ଯଦି ତାର ବଳ ଥାନ୍ତା ସତରେ ମଜା ଆସିଯାନ୍ତା । ମୁଁ ତାକଡ଼ି ଏ Physics ଆସୁନୁ ଆଜି Newton’s Laws of Motion ପଢ଼ିବା । ସିଏ ଆପେ ଆପେ ଆକରୁ ଚାଲି ଚାଲି ମୋ table ଉପରକୁ ପଲେଇ ଆସନ୍ତା । ଆଉ ରାଗିଥିଲେ ଆସନ୍ତାନି । ପୁଣି ତା ପାଖକୁ ଯାନ୍ତି ତାକୁ ଆଣିବାକୁ । ସେ ଛାଟି ପିଟି ହୁଅନ୍ତା । ଛାଡ଼ ମତେ ... ତୁ ବି ଦିନ ହବ ଖାଲି କାଲିଆ ମଲାଟର ଅଙ୍କ କଷ୍ଟୁଛି । ଯାଉନି ତା ପାଖକୁ । ମୁଁ ଯିବିନି । ମୁଁ କିନ୍ତୁ ଜୋର ଜବରଦସ୍ତ ଖୋଲିଲାବେଳେ ସେ page ଖୋଲିବାକୁ ଦିଅନ୍ତାନି । ମୋଡ଼ି ହେଇଯାନ୍ତା ।

ଏ କ’ଣ ସତରେ ବହିଟା ମୋଡ଼ି ଦେଇଯାଉଛି । ଇଏ କଣ !!! ମୋ ମନ ବି ବହି ସାଙ୍ଗେ friend ହେଇକି ତାକୁ support କରି କହୁଛି ଅନାମୀ ତୁ ଆଜି ଖୋଲିବୁନି ଜମାରୁ । ମୁଁ ତାକୁ କହିଲି ବାଲିଯାତ୍ରା ଯିବାକୁ ମନା କରୁଛି ପା । ବହି କହିଲା ଶୁଣ ମନ ... ମୁଁ ଖୋଲିବିନି ଆଜି; କିନ୍ତୁ ଗୋଟେ ସର୍ତ୍ତରେ । ବାଲିଯାତ୍ରାରୁ ଭଲ cover ଟେ ଆଣିବୁ । ଘୋଡ଼େଇ ହେବି ଶୀତ ଲାଗୁଛି ଭାରି । ଆଉ ଏ ତୁଷାର ଆକ ଝାଡୁନି ଜାମରୁ ମଇଳା ଯେ ମଇଳା । cover ଟା ରହିଲେ ମୁଁ ଟିକେ ସଫା ଦେଖା ହେବି ।

ମୁଁ ମୋ ମନ ଏବଂ ମୋ ବହିର conspiracy ରେ ରାଗିକି Economics ବହି ପାଖକୁ ଗଲି ଆଣିବାକୁ । ସେ ବି ଆସିଲାଣି । ଯଉ ବହି ପାଖକୁ ଗଲାବେଳକୁ ସେମାନେ ଡେଇଁ ପଡ଼ି ଆଉ ଆକକୁ ଚାଲି ଯାଉଛନ୍ତି ଅଭିମାନରେ ହଉ

ଅବା ରାଗିକି । ଖାଲି ଏପଟ ସେପଟ ଦେଇଛନ୍ତି । କିଛି ଗୋଟେ ହେଉଛି ଏମାନଙ୍କର । ଆଜି ହର୍ତାଳ କରୁଛନ୍ତି Kejriwal ଭଳିଆ । ଚିଲେଇ ଚିଲେଇ କହିଲି ରୁହ ତମ କଥା ବୁଝା ହବ । ସେଇଠୁ ଟିକେ ଶାନ୍ତ ହେଲେ । “ଯାଜ୍ଞସେନା” leader ହେଉକି ଆସିକି କହିଲା ଆମର ବହୁତ complain ଅଛି ତମ ବିରୁଦ୍ଧରେ । ସମସ୍ତେ ଗୋଟି ଗୋଟି କରି complain ଉପସ୍ଥାପନ କରିବେ ।

History ବହି ଆଗକୁ ଆସି କହିଲା ତମେ ମତେ ମନେରଖୁ ପାରୁନାହିଁ ବୋଲି ଗାର ମାରି ମାରି ପଡୁଛ । ମୋତେ ଭାରି କଷ୍ଟ ହଉଛି । ବେଳେବେଳେ ହାତ ଗୋଡ଼ ଛିଡ଼ି ଯାଉଛି ଗାର ମାରିଲା ବେଳେ । ଗାର ମାରିବା ବନ୍ଦ କରାଯାଉ । Physics ତରଫରୁ H. C. Verma ବହି ଆସି କହିଲେ +2 ପିଲାମାନେ ମୋତେ ଏତେ କଷ୍ଟୁଛନ୍ତି ଯେ, ମୁଁ ନିଜେ stress ରେ ଆସିଯାଉଛି । ଯିଏ ମୋତେ ଠିକ୍ ସେ କଷ୍ଟ ପାରୁନି ସିଏ ବେଶୀ stress ରେ ରହୁଛି । ମୁଁ ଚାହୁଁନି ମୋ ନାତିମାନେ ଏତେ କଷ୍ଟ କରନ୍ତୁ ମୋତେ କଷ୍ଟିବାରେ । Biology ବହି କହିଲା Medical ପିଲାମାନେ ମୋତେ Highlighter ମାରି ମାରି ମୋ skin ଖରାପ କରିସାରିଲେଣି । Highlighter ବନ୍ଦ କରାଯାଉ ।

ପୁରୁଣା ବହିମାନେ କହିଲେ ଆମେ କଲା ଓ ମଳିଛିଆ ଦେଖାଯାଉଛି ବୋଲି ଆମକୁ କେହି ପଚୁନାହାନ୍ତି । ତମେ ନୂଆ dress କିଣି ପିନ୍ଧୁଛ । ଆମକୁ ନୂଆ ମଲାଟ ଦଉନ କାହିଁକି ? ? Modi ସ୍ୱଚ୍ଛ ଭାରତ ଅଭିଯାନରେ କେତେ ସଫା କଲାଣି ଦେଶକୁ । ତମେ shelf ସଫା ଜମା କରୁନ । shelf ସଫା କରାଯାଉ । ଛୋଟ ଚଟି ଗଛ ବହିଟିଏ କାନ୍ଦି କାନ୍ଦି କହିଲା ତମେ ମତେ ଆଉ ଆଗଭଳି ଭଲ ପାଉନ । ମୁଁ ପତଳା, ମଳିଛିଆ ଦେଖାଯାଉଥିବାରୁ ତମେ ମତେ ଛାଡ଼ି ସେ ଚକଚକିଆ ସହରୀ 6 pack ବାଲା handsome Tata Mcgraw Hill ଭଲ ପାଉଛ । ମୋର ଭାରି ରାଗ ତମ ଉପରେ ।

Novel ଟିଏ ବାହାରି ଆସି କହିଲା ଯେବେଠୁ Google Playbooks. Kindle. E- Books ଆସିଲାଣି ମତେ ଆଉ କେହି ଛୁଡ଼ି ନାହାନ୍ତି । ମୁଁ ଅଜାତିଆ ହେଉଯାଉଛି । ମୁଁ ଶରୀର ତ୍ୟାଗ କରିଥିଲା ଭଳିଆ ଲାଗୁଛି । ବହୁତ ଜାଗାରେ Digital Library ଖୋଲିଲାଣି । ଲୋକ ମୋତେ smart phone ରେ swipe କରି କରି ପଡୁଛନ୍ତି ଆଉ ତ ସାଙ୍ଗରେ girl friend ବହୁତ ଖରାପ ଖରାପ କଥା chat କରୁଛନ୍ତି । ମରିଯିବା ମୋ ପାଇଁ ଶ୍ରେୟସ୍କର । “Certificates” ସବୁ ବାହାରି ଆସି କହିଲେ ଆମର ବି ସତ୍ତା ଯିବ କିଛି ଦିନ ଭିତରେ Digital Locker System ଆସିଲେ । ଲୋକ ମତେ Internet ରୁ download କରିବେ । ମୋତେ ନେଇ Tissue paper କରିଦେବେ ।

ମୁଁ ବା ନିସ୍, ନିଃସହାୟ, ନିର୍ବାକ । ସବୁ ଶୁଣିଥାଏ । ବହି-ବିଦ୍ରୋହରେ ମୁଁ ମର୍ମାହତ । “ଯାଜ୍ଞସେନା” ଶେଷରେ କହିଲା ବହିର ବ୍ୟକ୍ତିତ୍ୱକୁ ଫେରାଇ ଆଣି ପାରିବେ କି ? ? ନ ହେଲେ ବହି-ବିଦ୍ରୋହ ଜାରି ରହିବ । ମୁଁ ବିଳି ବିଳି ହେଇ ବୁଝେଇବାକୁ ଚେଷ୍ଟା କଲାବେଳେ newspaper ଟିଏ ରାଗିକି ଆସିକି ମୋତେ ଶକ୍ତ ଚାପୁଡ଼ାଟେ ପକେଇ କହିଲା e-newspaper ପଢ଼ିବୁ ନା !!! ମୋ ନିଦ ଭାଙ୍ଗିଗଲା । ଦେଖୁଲି ମୁଁ ବହି ଉପରେ ଶୋଇପଡ଼ିଛି । ଆଉ ସେ ବି ରାଗିକି ମୋଡ଼ି ହେଇଯାଇଛି । shelf କୁ ଅନେଇଲି । ପୁରା ଶୂନ୍ୟଗାନ । ସମସ୍ତେ ମତେ ଜକ ମକ କରି ଅନେଇଛନ୍ତି । “ଯାଜ୍ଞସେନା” କୁ ଅନେଇଲି ଆଉ ପଚାରିଲି ବହି-ବିଦ୍ରୋହ ଚାଲୁଛି କି ? ? ସେ କିନ୍ତୁ ଖାଲି ହସୁଥାଏ ।



ଆଉ ନାହିଁ ବିଶ୍ୱାସ

Er. Sashidhar Behera,
Lecturer in Civil,
Odisha School of Mining Engineering, Keonjhar

ଆଜି କି ତୋ ଚେହେରା ଲୁଚି ରହିଛି ମୋ ଆଖିରେ
ଆଜି ବି ତୋ ନୀରବତା ଲିଭୁ ନାହିଁ ମୋ ଛାତିରେ
ମନେ ପଡୁ ମନେ ପଡୁ ତୁ ପ୍ରତି ମୁହୂର୍ତ୍ତରେ

ତୁ ଚାଲିଯିବାଟା ଦୋଷ ନୁହେଁ ତୋର
ଜାଣେ ତୁ ଫେରିବୁନି
ସମୟ ଖେଳିଦେଲା ତୋ ଭାଗ୍ୟର ଖେଳ
ସେ କଥା ଭାବିଲେ ଆଜି ବି ଥରି ଉଠେ ଦେହ ମୋର
ଆଉ ନାହିଁ ବିଶ୍ୱାସ ଏଇ ଜନମର । ୧ ।
ସପନ ଦେଖିବା ଦିନରୁ କିଏ ଜାଣିଥିଲା

ରାତିର ଦୂରତା କେତେ
ସରୁନି ଅନ୍ଧାର ଆସୁନି ଆଲୁଅ ଚାଲୁଛି ବାଟ ମୁଁ ଯେତେ,
ନିଃଶ୍ୱାସ ଛାଡ଼ିବା ଆଗରୁ ଦେଖା କରିଲୁନି
ପବନ ଆସି ମୋତେ
ଏବେ ବି ମୋ ଆଖି ପଲକ ଖୋଜୁଛି ତାରା ଗହଳିରେ ତୋତେ । ୨ ।
ସମ୍ପର୍କ ଗଢ଼ିବା ଦିନରୁ ଲାଗୁଥିଲା ମୋତେ

ନିଜଠୁ ବି ବେସି ନିଜର
ନିଜର ଲାଗିବାଟା ହେଲା ଶେଷଦେଖା ପଡ଼ି ଗଲା କାଳ ନଜର,
ବିଶ୍ୱାସ ବାନ୍ଧିବା ଆଗରୁ ବସା ଭାଙ୍ଗିଗଲା
ଭାଗ୍ୟ ହେଲା କେତେ ନିଷ୍ଠୁର
ତଥାପି ହାରିନି ବଞ୍ଚିଛି ଲୁହରେ ଛାତିକୁ କରି ମୁଁ ପଥର । ୩ ।



ବାତାୟନ କହିବ

Tushar Das Pattnaik

Lecturer in Metallurgy

OSME, Keonjhar

ଓହ କି ଖରା ! ଏବର କରାଳ ନିଦାଘରେ ଆମର ବହୁତ ବ୍ୟବହୃତ ଜିନିଷ ମଧ୍ୟରେ ବାତାୟନ ବା ଝରକାର ବ୍ୟବହାର ଓ ଅପର ପକ୍ଷରେ ତାର ସହଯୋଗ ଅନୁଳନୀୟ । କେବେ ତରେ ଝରକାକୁ ପଚାରିଛ ତୁମକୁ କିପରି ଲାଗୁଛି । ଅଜସ୍ର ଯେ ନବ କଳେବର ହେଲା ହେଲା ନହେଲେ ନାହିଁ । ତା'ର ସେ ଭାଗ୍ୟ କାହିଁ । ପବନ ଆମ ପାଇଁ ମିତ୍ର ହେଇ ପରେ ହେଲେ ତା ପାଇଁ ପରମ ଶତ୍ରୁ । ଯଦି ଖୁଡ଼ିକା ଦିଆ ନ ହୋଇ ଥାଏ ଢୋ ଢୋ ଆବାଜରେ ଖାଲି ପିଟି ହୋଇଯାଉଥାଏ । ପବନକୁ ସେ କିଛି କହିପାରେନି । ତାକୁ ଭାରି କଷ୍ଟ ହଉଥିବ ନା । ଛୋଟ ପିଲାମାନେ ବହୁତ ଆନନ୍ଦ ନିଅନ୍ତି ଏହି ଢୋ ଢୋ ଶବ୍ଦରେ । ବୁଢ଼ା ଓ ବୁଢ଼ାମାନେ ବିରକ୍ତ ହୋଇଯାନ୍ତି । ଆଉ ମା' ଦଉଡ଼ି ଆସି ଖୁଡ଼ିକା ଦେଲାବେଳେ ବାତାୟନ ଭାବେ ଟିକେ ଧନ୍ୟବାଦ କହିପାରନ୍ତି କି । ଖରା, ବର୍ଷା, ଶୀତର ସାଥୀ ଏ ଝରକା । ନିଦାଘର ନିଃସୂତ ଉଷ୍ମତା ସହେ ସେ । ବର୍ଷାର ବିଭୀଷିକାକୁ ଅଟକାଏ ସେ । ଶୀତର ଶୀର୍ଣ୍ଣତା ଲହରୀରୁ ବଞ୍ଚାଏ ସେ । ବେଳେବେଳେ ବସି ଭାବେ ବାତାୟନ କଥା କହି ପାରନ୍ତା କି ? ? ? ମୁଁ ଟିକେ ମନ ଖୋଲି ପଦେ ଦି ପଦ କଥା ହୁଅନ୍ତି । ସକାଳେ ମୁଁ ଯେବେ ଝରକା ଖୋଲେ, ସୁଲୁ ସୁଲୁ ପବନ ସହିତ କେତେ ଯେ ସ୍ମୃତି ଭାସି ଆସେ । ସେ ପିଲାବେଳର ଲୁଚକାଳି ଖେଳ, କିଆରୁଦାରେ ନିଆଁ ଲଗେଇ ବାବାଙ୍କୁ ମାଡ଼ ଖାଇବା, ସ୍କୁଲ ସମୟରେ ସାଇକେଲ ହ୍ୟାଣ୍ଡେଲ ଛାଡ଼ି ସାଙ୍ଗମାନଙ୍କ ସାଙ୍ଗେ ପ୍ରତିଯୋଗିତା କରିବା ଆଉ କଲେଜ ସମୟର କେତେ କଥାମନେ ପଡ଼ିଥାଏ । କେତେ ଯେ ପ୍ରେମିକଙ୍କ ପାଇଁ ପ୍ରେମିକା ସାଜି ପ୍ରେମିକର ପାଗଳାମିର ମୂଳ ସାକ୍ଷୀ ସାଜିଛି । ନ ବୁଝି ପାରିଲେ ବି ସେ ସବୁ ବୁଝିପାରେ । ଆହୁରି ଶୀତଳ ପବନ ସହିତ ସ୍ମୃତି ବରଷି ଦିଏ ।

ଖାଲି ଘର ନୁହେଁ କାର, ବସ ସବୁ ଜାତିର ବାତାୟନଙ୍କ ଅବସ୍ଥା ଭାରି ଖରାପ । ହେଲେ ସେମାନେ ନିସ୍ୱାର୍ଥପର ଭାବେ ଆମ ସେବାରେ ତାଙ୍କର ଜୀବନ ଉତ୍ସର୍ଗ କରିଛନ୍ତି । ଆମେ କ'ଣ ଝରକାରୁ କିଛି ଶିଖୁ ନାହାନ୍ତି ? ? ସେ ବା ଆମକୁ ନ କହି କେତେ କଥା ଶିଖାଉଛି । ଠକ୍ ଠକ୍ କରି କିଏ କବାଟ ବାଡ଼େଇଲା । ଖୋଲିଲା ବେଳେ ଡେବର ଭାଇନା ଅର୍ଡର ନବା ପାଇଁ ଆସିଛନ୍ତି । କହିଲେ ଭାଇନା ସାର ଝରକା ବା ଖୋଲୁ ନାହାନ୍ତି । ସେ ପକେଇଲାବେଳେ ମୁଁ ଭାବୁଥାଏ ଖୋଲା ଆଉ ବନ୍ଦ ଭିତରେ ଜୀବନ ବା ସରିଗଲା ଝରକାର । ମନେ ହୁଏ ଦିନେ ସେ କଥା କହିବ । ତା'ର ହସ ଖୁସି ବାଣ୍ଟିବ । ଆମେ ସାଙ୍ଗ ହବୁ । ହେଲେ ବାତାୟନ କହିବ ତ ? ? ? ? ?



କହିଦେ ତୁ ହଁ ଥରେ

Er. Sashidhar Behera,
Lecturer in Civil,
Odisha School of Mining Engineering, Keonjhar

ଯେବେଠୁ ଦେଖୁଛି ତୋତେ ମୋ ଆଖି ପଲକ ପଡୁନି
ମୁଁ କହିବି କାହାକୁ
ଯେବେ ମୁଁ ଭାବୁଛି ତୋତେ ମୋ ଆଗରେ ତୁ ନାହୁଁ
ମୁଁ ଦେଖୁଛି ଯାହାକୁ
କାନରେ ଶୁଭୁଛି ମୋର ନା ତୋର ଆସି
ମୋତେ ଲାଗେ ତୋ ଛୁଆଁରେ ଯାଉଛି ମୁଁ ଭାସି
କିଛି ପ୍ରେମ ଉଠିମାନେ କହିବି କାହାକୁ
କହିଦେ ତୁ ହଁ ଥରେ ପ୍ରିୟ
ରାତ୍ର କରୁ ଉଠେଇନେବି ମୋ ଦୁନିଆକୁ । ୧ ।
ମୋତେ ଲାଗେ ମୁଁ ପାଗଳ ବୋଧେ ହେଇ ଯାଇଛି ତୋ ପ୍ରେମରେ
ସେଇ ପ୍ରେମକୁ ମନ ଦେବା ପାଇଁ ଜାଗାଟେ କିଛି ଜନ୍ମରେ
ଆଉ କିଛି ଭାବନା ଆସେ ନାହିଁ ତୋ ବିନା ମୋ ମନରେ
ଭାବନାକୁ ସବୁ ସାଜତି ରଖୁଛି ମୁଁ ତୋ ପାଇଁ ମୋ ଗୀତରେ ... । ୨ ।
ଜହ୍ନା ହୁଏ ଟିକେ ହାତ ଛୁଇଁବାକୁ ବସି ତୋର ପାଖରେ
ହଜାରେ ସପନ ଦେଖୁଛି ତୋତେ ମୁଁ ଲାଗୁ ତୁ ଅଛୁ କାଲି ଦୂରରେ
ବାଟ ଚାଲୁ ଚାଲୁ ଥକି ଯାଏ ଯଦି ଶୋଇଯିବି ତୋର ବାହୁରେ
ଶ୍ରାବଣ ଭିଜା ଲୋଡ଼ା ନାହିଁ ମୋର ତୁ ଥିଲେ ପ୍ରିୟା ପାଖରେ ... । ୩ ।



ପରିବର୍ତ୍ତିତ

A. N. Arpita Aparajita

Lecturer in Physics
Govt. Polytechnic, Bhadrak

ଆଜି ଅନେକ ଦିନ ପରେ
ଲେଖନୀ ଧରିଲି ।
ହେଲେ ଶବ୍ଦମାନେ ଧରା ଦେଲେନି ।
ଖୋଜି ବୁଲିଲି, ଅଧୀର ହେଲି
ପ୍ରାପ୍ତେ ଥିଲା ନିରାଶା ଯା’
ଖାଲି ମୁଁ ବାଟବଣା ହେଲି ।

ଖୋଜୁ ଖୋଜୁ ଝୁଞ୍ଚି ପଡ଼ିଲି...
ସାମ୍ନେ ମୋର ବଡ଼ ପାହାଡ଼ଟେ
କ୍ଷତାକ୍ତ ହେଲି, ରକ୍ତାକ୍ତ ହେଲି
ଦେଇ ଧାନ ବୁଝିଲି ମୁଁ
ପାହାଡ଼ ନୁହେଁ ଯେ
ସେ ମୋ ଭାବନାରେ ପରିବର୍ତ୍ତିତ ରୂପଟିଏ ।



“ମରାଠିକା”

Subhasmita Nayak

Lecturer in Civil

Govt. Polytechnic, Mourbhanja

ସୁଦୂରରୁ ଦିଶେ ସୁନାହରିଣୀ,
ପାଖକୁ ଗଲେ ସେ ହଜିଗଲାଣି ।
ତୃଷ୍ଣାର୍ଥ ଖୁସି ହୁଏ ଦେଖୁଦେଲେ ଜଳ,
ସେଇ ଜଳ ନ ପାଇଁ ସେ ହୁଏ ଅବିଚଳ ।
ସତରେ ସେ ନ ଥାଏ କେବେ ଧରାପୃଷ୍ଠରେ,
ଅନୁଭବ କରାଏ କିନ୍ତୁ ସଭିଜ୍ଞ ମନରେ ।
ଜଳ ପରି ଦିଶୁଥାଏ ସେ ଜଳ ସଦୃଶ,
କହିଦିଏ ସେ ମୋତେ ଧରିନିଅ ଆସ ।
ଖରାର ଆଗମନରେ ହୁଏ ତାର ଆବିର୍ଭାବ,
ଅନ୍ତର ପ୍ରସନ୍ନ ହୁଏ ଦେଖୁ ତାର ସ୍ୱଭାବ ।
ଏଭଳି ଦୃଶ୍ୟ ଦେଖୁ ମନ ମୟୂରୀ ନାଚିଉଠେ,
ପୁଣି ଅଦୃଶ୍ୟ ପାଇ ମନ ମୋର କାନ୍ଦିଉଠେ ।
ଯାତ୍ରା ସମୟରେ କ୍ଷଣିକ ଖୁସି ସିଏ,
ସମୟ ବ୍ୟବଧାନରେ ମନ ଜିଣେ ଯିଏ ।
ଆମ ସହ ଖେଳି ବୁଲେ ଲୁଚି ଲୁଚିକା,
ହେଉ ପଛେ ସେ ମିଛ ମିଛିକା ।
ସେ ହେଉଛି ଆମ ଅଦିନିଆ ପ୍ରେମିକା,
ନା’ ଥାଇ ବି ସେ ହେଉଛି ଅନାମିକା ।
ଧରିତ୍ରୀ ମା’ର ସେହି ମହାନାୟିକା,
ହୃଦୟର ରାଣୀ ସିଏ ନା’ ତାର “ମରାଠିକା” ।



ସବୁଜ ସୁନ୍ଦର ଆମ ପରିବେଶ

Suvendu Muduli

Lecturer in Govt. Polytechnic, Ragadi, Jajpur

ସବୁଜ ସୁନ୍ଦର ଆମ ପରିବେଶ

ଲାଗେ କେତେ ଆପଣାର

ଶସ୍ୟଶ୍ୟାମଳା ପ୍ରକୃତି ରାଣୀ

ଦିଶଇ କି ମନୋହର ।୧।

ଆପଣା ସ୍ୱାର୍ଥରେ ଅନ୍ଧହୋଇ ଆମେ

ଭୁଲି ହିତାହିତ ଜ୍ଞାନ

ଜଙ୍ଗଲ କାନ୍ଦି ପ୍ରଦୂଷି କରୁ

ନିଜ ପରିବେଶ ଜାଣ ।୨।

ଆମର ପ୍ରଗତି ହେବସିନା ଭାଇ

ହେଲେ ଦ୍ରୁତ ଶିଳ୍ପାୟନ

ପରିବେଶ ଯଦି ସୁସ୍ଥ ନରହିବ

ସବୁକିଛି ମୂଲ୍ୟହୀନ ।୩।

ହେବ ଯଦି ବାୟୁ, ଜଳ, ଶବ୍ଦ ତଥା

ମୃତ୍ତିକାର ପ୍ରଦୂଷଣ

ଧୂଂସମୁଖୀ ହେବ ଆମରି ପୃଥିବୀ

ଏ କଥାଟି ସତ୍ୟ ଜାଣ ।୪।

ମାତ୍ର ପ୍ରତିକାର ଆମରି ହାତରେ

ରହିଅଛି ଯେ ତାହାର

ନକାଟି ଜଙ୍ଗଲ ନୂତନ ବୃକ୍ଷ

ରୋପଣ କରିବା ସାର ।୫।

ବନ୍ୟଜନ୍ତୁ ସଂରକ୍ଷଣ କରୁଥିବା

ଜନସଂଖ୍ୟା ନିୟନ୍ତ୍ରଣ

ନିଜ ସ୍ୱାର୍ଥ ପାଇଁ ନ କରିବା କେବେ

ପରିବେଶ ପ୍ରଦୂଷଣ ।୬।

କରିବା ଶପଥ ରଖିବା ମହତ

ଆମ ଧରଣୀ ରାଣୀର

ତା'ର ପରିବେଶ ସୁରକ୍ଷା କରିବା

ଅଟେ ଦାୟିତ୍ୱ ଆମର ।୭।

ସବୁଜ ସୁନ୍ଦର ଆଉ ସ୍ୱାସ୍ଥ୍ୟପ୍ରଦ

ରଖିବା ତ ପରିବେଶ

ସାର୍ଥକ ହୋଇବ ଜୀବନ ଆମର

ଫୁଟିବ ମୁହଁରେ ହସ ।୮।

ପରିବେଶ ଆଉ ପ୍ରକୃତିର ରକ୍ଷା

ହେଉ ଜୀବନର ଧ୍ୟେୟ

ଆମ ପରିବେଶ ହେବ ସୁରକ୍ଷିତ

ହେବ ପୁଣି ମଧୁମୟ ।୯।

ବିଶ୍ୱବାସୀ ଆମେ ହୋଇ ଏକତ୍ରିତ

ଆମ କରିବା ଶପଥ

ଆମ ପରିବେଶ ଆମେ ବଞ୍ଚାଇବା

ହୋଇ ପୂର୍ଣ୍ଣ ସମର୍ପିତ ।୧୦।

