Manufacture of Value Added Products from Rice Husk (Hull) and Rice Husk Ash (RHA)

(Precipitated Silica, Activated Carbon, Cement, Electricity, Ethanol, Hardboard, Oxalic Acid, Paper, Particle Board, Rice Husk Briquettes, Rice Husk Pellet, Silicon, Sodium Silicate Projects)
Introduction

Rice hulls (or rice husks) are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, rice hulls can be put to use as building material, fertilizer, insulation material, or fuel. Rice hulls are the coatings of seeds, or grains, of rice.
The husk protects the seed during the growing season, since it is formed from hard materials, including opaline silica and lignin. The hull is mostly indigestible to humans.

India is a major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and / or by gasification. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Lots of ways are being thought of for disposing them by making commercial use of this RHA. Rice husk is an agriculture residue abundantly available in rice producing countries.
Global production of rice is approximately 580 million tons a year, and this is rising as the world population and the consumption of rice increases. Rice husk is generally not recommended as cattle feed since its cellulose and other sugar contents are low. Furfural and rice bran oil are extracted from rice husk. Industries use rice husk as fuel in boiler and for power generation. Among the different types of biomass used for power generation, rice husk has a high ash content varying from 18 – 20%, silica is the major constituent of rice husk ash.
Rice husk ash (RHA) is a by-product from the burning of rice husk that can have favorable effects on the soil in terms of acidity correction. The burning of rice husk for power generation in industries has generated a new residue consisting of a mixture of ash, charred hull and fresh rice husk fractions.

Rice husk is a potential material; there are many usage of rice husk either in the raw form or in ash form. Most of the time husk from the mill is either burnt or dumped as waste in open fields and a small amount is used as fuel for boilers, electricity generation, bulking agents for composting of animal manure, etc.
Rice husk is the outermost layer of protection encasing a rice grain. Rice husk was largely considered a waste product that was often burned or dumped on landfills. Many ways are being thought for disposal of rice husk and only a small quantity of rice husk is used in agricultural field as a fertilizer, or as bedding and for stabilization of soils. Therefore, the use of rice husk as rice husk ash is one of the most viable solution. The husk can be used for poultry farming, composting or burning. In the case of burning, it has been used as biomass to power reactors to generate thermal or electrical energy.
India is a major rice producing country and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and/or by gasification.

The rice husk ash causes more environmental pollution and its disposal becomes a problem, hence requires attention regarding its disposal and its reuse. The ash is mainly composed of carbon and silica due to which it is used to manufacture different value added products. This book provides thorough information to utilize RHA with process pathway for economically valuable products.
Use of rice husk ash with cement improves workability and stability of the concrete mixture. It reduces heat generation, thermal cracking, and plastic shrinkage of the material. It also helps in increasing strength, impermeability, and durability of the mixture during the setting period by modifying the pore-structure and blocking the large voids in the hydrated cement paste through pozzolanic reaction. The properties of rice husk ash improves the performance of cement, bricks, and other construction materials.
Increasing demand for rice husk ash in the building & construction application segment is one of the major factors fueling the growth of the overall rice husk ash market.

The global rice husk ash market is projected to reach USD 2.42 Billion by 2020, at a CAGR of 5.15% from 2015 to 2020.
This handbook explains manufacturing process with flow diagrams of various value added products from rice husk & rice husk ash, photographs of plant & machinery with supplier’s contact details and sample plant layout & process flow sheets. The major contents of the book are rice husk, rice husk ash (RHA), precipitated silica from rice husk ash, activated carbon from rice husk, cement from rice husk ash, electricity from rice husk, ethanol from rice husk, hardboard from rice husk, oxalic acid from rice husk, paper from rice husk,
particle board from rice husk, rice husk briquettes, rice husk pellet, silicon from rice husk, sodium silicate from rice husk, packaging.

This book will be a mile stone for the entrepreneurs, existing units, professionals, libraries and others interested in recovery of value added products from rice husk (rice hull) & rice husk ash to explore an economic way for recycle and reuse of agricultural waste.
1. **Rice Husk (Hull)**
   Composition of Rice Husk
   Properties of Rice Hull
   Use & Applications of Rice Husk
   (a) As an Industrial Fuel
   (b) Preparation of Activated Carbon
   (c) Rice Husk as a Fertilizer and Substrate
   (d) As Pet Food Fiber
   (e) Substrate for Silica and Silicon Compound
   (f) Used for Making Bricks
   (g) Rice Husk as Fireworks
   (h) Used as Pillow Stuffing
   (i) Other Uses
   Rice Husk as an Adsorbent for Heavy Metals
2. **Rice Husk Ash (RHA)**

**Physical Properties of Rice Husk Ash**

**Chemical Composition of Rice Husk Ash**

**Applications**

Use of RHA in Several Industrial Applications

1. As a Replacement to Silica Fume
2. As an Admixture in Low Cost Concrete Block Manufacturing
3. As a Tundish Powder in Steel Casting Industries
4. Manufacturing Refractory Bricks
5. Control of Insect Pests in Stored Food Stuffs
6. In the Vulcanizing Rubber
7. In the Water Purification
8. As a Flue Gas Desulphurization Absorbent
3. **Precipitated Silica from Rice Husk Ash**

Typical Properties

Physico - Chemical Characteristics of Precipitated Silica

1. pH Value
2. Drying Loss
3. Ignition Loss
4. DBP Absorption
5. SiO2 Content
6. SIEVE Residue
7. Tamped Density

Uses & Applications

Rubber Grade Precipitated Silica
Non Rubber Grade Precipitated Silica

Manufacturing Process

Digestion
Precipitation
Regeneration

Process Flow Diagram
4. Activated Carbon from Rice Husk
   Forms of Activated Carbon
   Physical Characteristics
   Uses and Applications of Activated Carbon
   Manufacturing Process

5. Cement from Rice Husk Ash
   Varieties of Cement
   Uses of Cement
   Manufacturing Process
   1. Manufacture of Lime
      Calcination
      Hydration
   2. Manufacture of Burnt Rice Husk
   3. Mixing & Grinding
   4. Packing & Forwarding
6. **Electricity from Rice Husk**
   - Procedure of Electricity Generation from Rice Husk
   - Downdraft Gasification
   - Purification Unit
   - Turbine and Generation Unit

7. **Ethanol from Rice Husk**
   - Ethanol is Used
   - Chemical Properties of Ethanol
   - Grades of Ethanol
   - Denatured Alcohol
   - Absolute Alcohol
   - Rectified Spirits
   - Manufacturing Process
   - Cellulosic Ethanol
   - Purification Distillation
   - Process Flow Diagram
8. Hardboard from Rice Husk

- Properties
- Uses of Hardboard
- Furniture
- Construction
- Auto Industry
- Packaging and Other Manufacturing Processes
- Blending
- Adhesive Preparation
- Adhesive Mixing
- Mat Formation
- Cole Pressing
- Hot Pressing
- Sanding and Finishing
- Process Flow Diagram
10. **Paper from Rice Husk**
   - Uses & Applications
   - Process of Manufacture for Rice Husk
   - Raw Material Storage & Preparation
   - Husk Pulping
   - Waste Paper Pulping
   - Screening of the Pulp
   - Pulp Beating & Refining
   - Sizing & Loading
   - Refining
   - Paper Making and Finishing

11. **Particle Board from Rice Husk**
   - Advantages of Particleboard
   - Uses & Applications
   - Manufacturing Process of Pre Laminated Board
   - Flow Sheet for Manufacturing of Pre-Laminated Particle Board
Traditional Approach for Manufacturing Rice Husk Particleboards
Adhesives in Particleboards
1. Synthetic Adhesives
   Phenol-formaldehyde (PF)
   Urea-formaldehyde (UF)
2. Natural adhesives
   Soybean Adhesive
   Starch Adhesive

12. Rice Husk Briquettes
    Various Types of Briquettes
    Biomass Briquettes
    Sawdust Briquettes
    Agro waste Briquettes
    Wood Briquettes
    White Coal Briquettes
    Uses of Briquettes
    Applications of Briquettes in Various Industries
13. **Rice Husk Pellet (RHP)**

Why Make Rice Husk Pellets?
Property of Rice Husk Pellet
Advantages of Pelletizing Rice Husk into Pellet
a. Good to Environment
b. Convenient
c. High Effectiveness
d. Wide Application

Manufacturing Process
a. Drying
b. Pelletizing
c. Cooling and Packing

Process Flow Diagram

14. **Silicon from Rice Husk**

Properties
Physical Properties
Chemical Properties
Electrical Properties
Uses
Uses of Silicon Based Products in Different Sectors
Computers and Electronics
Automobiles
Textiles
Household
Personal Care
Healthcare
Paper
Manufacturing
Food and Related Industries
Manufacturing Process
1. Digestion
2. Precipitation
3. Regeneration
Production of Silicon
Process Flow Diagram
15. **Sodium Silicate from Rice Husk**
- Sodium Silicate Physical and Chemical Properties…
- Uses of Sodium Silicate
- Properties of Sodium Silicate
- Manufacturing Process
- Safety Procedures in Handling Sodium Silicates
- Process Flow Diagram

16. **Packaging**
- Types of Packaging Materials
- Plastic
- Metal
- Brick Carton
- Cardboard
- Glass
- Functions of Packaging
- Containment
- Protection
- Convenience
Communication
Package Environments
1. Physical Environment
2. Ambient Environment
3. Human Environment
Levels of Packaging
Selection of Proper Packaging for Industrial Product
Flexible Industrial Packaging - Paper and Plastic
Rigid Industrial Packaging - Wooden, Metal, Plastic
Labelling
Labels for Chemical Products

17. **BIS Specifications**
Cement
Activated Carbon
Particle Board
Silicon
Silica  
Sodium Silicate  
Oxalic Acid

18. Photographs of Plant & Machinery with Supplier’s Contact Details  
19. Sample Plant Layout & Process Flow Sheets
Niir Project Consultancy Services (NPCS) can provide Process Technology Book on Manufacture of Value Added Products from Rice Husk (Hull) and Rice Husk Ash (RHA)

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- Activated Carbon & Activated Charcoal
- Aluminium And Aluminium Extrusion Profiles & Sections,
- Bio-fertilizers And Biotechnology
- Breakfast Snacks And Cereal Food
- Bicycle Tyres & Tubes, Bicycle Parts, Bicycle Assembling
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- Biodegradable & Bioplastic Based Projects
- Chemicals (Organic And Inorganic)
- Confectionery, Bakery/Baking And Other Food
- Cereal Processing
- Coconut And Coconut Based Products
- Cold Storage For Fruits & Vegetables
- Coal & Coal Byproduct
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- Hospital Based Projects
- Herbal Based Projects
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- Minerals And Minerals
- Maize Processing (Wet Milling) & Maize Based Projects
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- Organic Farming, Neem Products Etc.
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- Spices And Snacks Food
- Steel & Steel Products
- Textile Auxiliary And Chemicals
Sectors We Cover  

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- Textiles And Readymade Garments
- Waste Management & Recycling
- Wood & Wood Products
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