



# **PG ROADS/ NEW PRODUCTS**

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# AERB NORM GUIDELINES IN INDIA



Atomic Energy Regulatory Board Guidelines in India are:

- **Analysis of Rock Phosphate and Phosphogypsum:** All rock phosphate processing industries shall carry out analysis to determine U-238 and Ra-226 content in each imported consignment of rock phosphate as well as in the phosphogypsum produced from its processing and shall report the results to AERB on quarterly basis. This data will be reviewed in AERB for a period of about two years for deciding on the frequency of such analysis in future.
- **Sale of Phosphogypsum by Fertilizer Plants:** AERB approval is not required for selling phosphogypsum for its use in building and construction materials provided the **activity concentration of Ra-226** in it is less than or equal to 1 Bq/g. [If Ra-226 concentration in phosphogypsum is more than 1Bq/g, it is to be mixed with other ingredients such that the Ra-226 activity concentration in bulk material is less than or equal to 1.0 Bq/g.]
- **Manufacturing and Use of Phosphogypsum Panels and Blocks:** AERB approval is not required for manufacturing and use of phosphogypsum panels or blocks provided they have Ra-226 activity less than 40 kBq/square metre area of any surface of the panels/blocks.
- **Use in Agriculture:** There is no restriction for use of phosphogypsum in agricultural applications from the radiological safety considerations.



## GUIDELINES



*In India, led by scientific, evidence-based evaluation PG no longer seen as a waste but as a valuable, multipurpose resource. Accordingly Central Pollution Control Board has Guidelines for Transportation, Storage, Management, Handling, Utilization & Disposal of Phosphogypsum*

- **Agriculture**
- Construction Materials
  - *Plaster/ Blocks/ Board*
- Cement Industries
- Ammonium Sulphate
- Sulphuric Acid
- Landfill/ Backfill
- **Road making**



# **PHOSPHOGYPSUM IN ROAD MAKING**

# ROAD MAKING

- PG MUST HAVE
  - COEFFICIENT OF PERMEABILITY NOT LESS THAN  $10^{-7}$  CM /SEC
  - IN CONSULTATION WITH THE CENTRAL ROAD RESEARCH INSTITUTE (CRRI) AS WELL AS THE RESPECTIVE SPCB OR PCC.

Specification of PG *for use as sub-base/ Sub-grade for road making:*

Name of the Parameter	Recommended Water Leachable Limit (not to exceed as per water leach test )
Fluoride	< 50 mg/l
Cadmium	< 2 mg/l
Lead	< 2 mg/l
Arsenic	< 1 mg/l
Mercury	< 0.1 mg/l
Moisture	< 15 %

# FEASIBILITY STUDY OF UTILIZATION OF PHOSPHOGYPSUM AS ROAD CONSTRUCTION MATERIAL

Entrusted to CSIR-Central Road Research Institute (CRRI) to assess suitability of Phosphogypsum (PG) as a road construction material

The broad scope of work was as follows:

- Characterization of Phosphogypsum
- Characterization of Soil / Flyash
- Use of phosphogypsum in road embankment and subgrade
- Use of Phosphogypsum in concrete roads
- Use of Phosphogypsum in Bituminous mixes of flexible pavements.

## TESTS AT CRRI

Samples were characterized as per BIS standards.

- The properties determined included physical characteristics such as specific gravity, particle size distribution, consistency limits i.e., Liquid & Plastic limit, natural moisture content, etc.
- In addition to the above, the optimum moisture content (OMC) at which the sample can be compacted to its maximum dry density (MDD) were also evaluated for further casting of samples for strength determination.
- The strength and engineering characteristics of Phosphogypsum alone and in combination with local soil, lime and flyash etc. were determined in terms of its Shear strength ; Unconfined compressive strength and California Bearing Ratio (CBR).

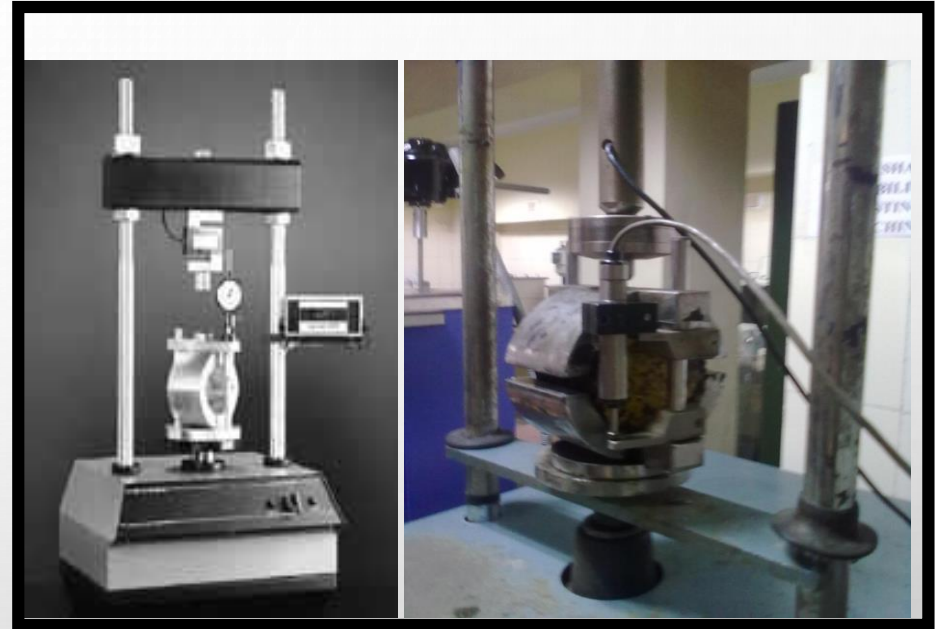


# **DETERMINATION OF STRENGTH**

**THE STRENGTH CHARACTERISTICS ARE STUDIED BY CASTING AND TESTING OF CUBES OF 100MM. SIDE, CYLINDERS OF 150MM. DIAMETER AND 300 MM. HEIGHT AND BEAMS OF 100MMX100MM X 500 MM IN ALL CASES OF WATER-BINDER RATIO WITH DIFFERENT PERCENTAGE REPLACEMENT BY PHOSPHOGYPSUM.**



# SPECIMENS



# FINDINGS

Based on laboratory data, it was found that phosphogypsum as such when compacted at Optimum Moisture Content (OMC) & Maximum Dry Density (MDD), yield very high strength.

**The shear strength parameters could not be determined on OMC & MDD. Therefore these parameters were determined at average natural moisture content of the phosphogypsum.**

The unconfined compressive strength (UCS) was good enough for its use in different pavement layers. However when this sample was soaked in water for the purpose of determining durability, it was found to lose some strength but still it has sufficient strength for use in sub base layer or as a capping layer over soft subgrade.

# FINDINGS

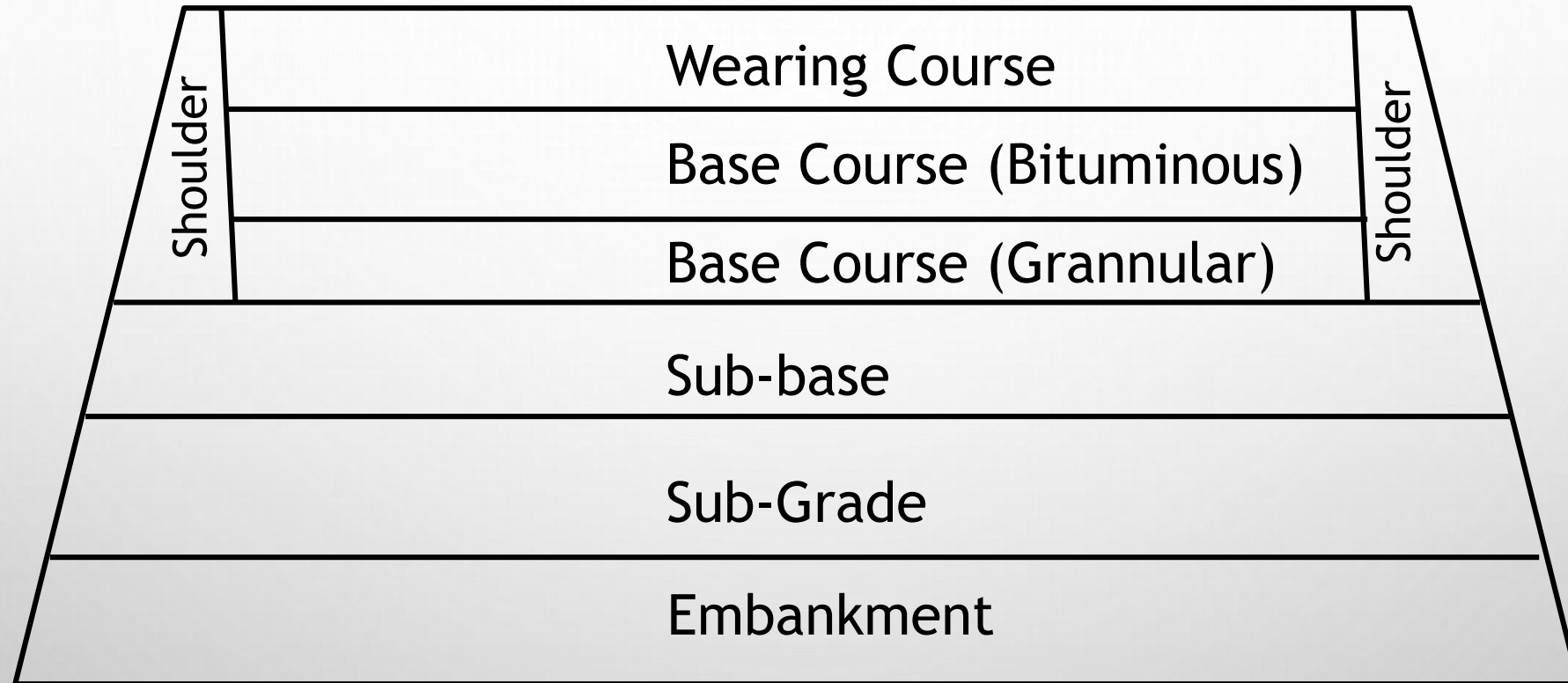
## SOIL:

- LOCAL SOIL USED STABILIZING WITH DIFFERENT PERCENTAGES OF PG UPTO 50%
- THERE WAS A GAIN IN UNCONFINED COMPRESSIVE STRENGTH(UCS) UPTO 20%
- BEYOND 20% STARTED DECREASING
- ADDITION OF LIME FURTHER INCREASES UCS

# CONCLUSION

- PG AS SUCH CAN BE USED AS A FILL MATERIAL IN SUB-GRADE/ SUB-BASE LAYER OF ROAD.
- SOIL WITH 20% PG & ~2% LIME CAN BE USED AS SUB-GRADE CAPPING LAYER
- FLYASH WITH 40% PG CAN BE USED AS SUB-GRADE CAPPING LAYER AND ALSO SUB-BASE LAYER.
- 7% PG CAN BE USED AS FILLER IN BITUMINOUS CONCRETE WHICH INCREASES STRENGTH OF THE MIX & RETAINED STABILITY OF THE MIX INDICATING REDUCED WATER INDUCED DAMAGES OF BITUMINOUS PAVEMENT.

# ROAD CROSS SECTION



**About 50~60% of the above will be of PG**



# ROAD PHOTOS





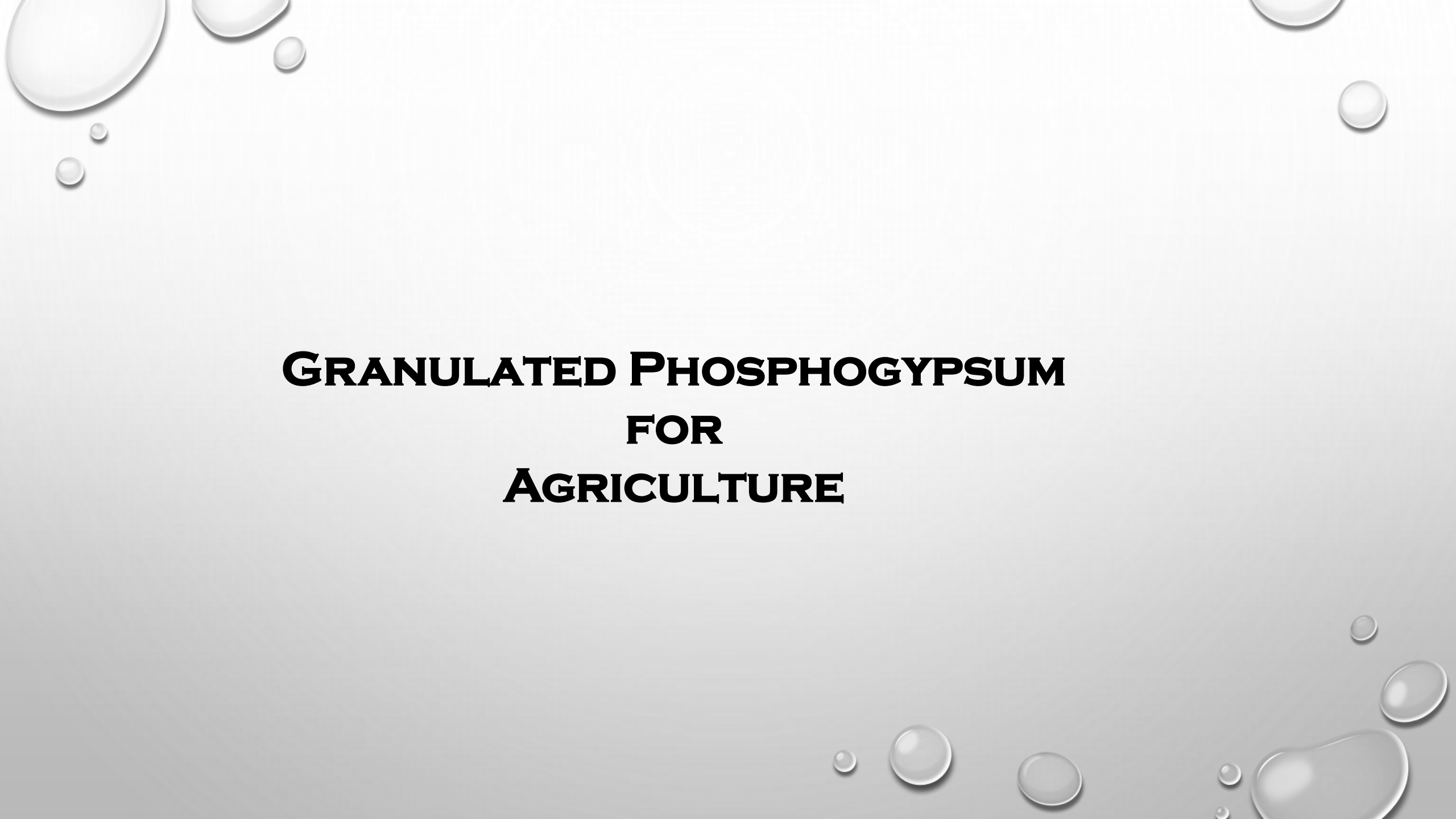
# ROAD PHOTOS





# ROAD PHOTOS



The image features a light gray background with a subtle radial gradient. In the top-left and bottom-right corners, there are clusters of realistic water droplets of various sizes, rendered with soft shadows and highlights to give them a three-dimensional appearance. Centered on the page is the main title, which is split into three lines.

# **GRANULATED PHOSPHOGYPSUM FOR AGRICULTURE**

# NUTRIENTS

NUTRIENTS ARE THE ESSENTIAL ELEMENTS REQUIRED FOR PLANT GROWTH AND COMPLETION OF THE PLANT LIFE CYCLE FROM SEED TO SEED. THE FUNCTION OF NUTRIENTS ARE AS FOLLOWS

- HELP THE PLANTS TO COMPLETE A FUNCTION AND LIFE CYCLE
- A DEFICIENCY CAN BE CORRECTED ONLY BY APPLICATION OF THE SPECIFIC NUTRIENT THAT IS DEFICIENT
- NUTRIENTS PLAY A DIRECT ROLE IN METABOLISM.

Primary Nutrients	Secondary Nutrients	Micro Nutrients
Nitrogen (N)	Calcium (Ca)	Boron(B), Copper (Cu)
Phosphorus (P)	Magnesium (Mg)	Iron (Fe), Manganese (Mn)
Potassium (K)	Sulphur (S)	Molybdenum (Mo), Zinc (Zn)
100's Kg/Ha	10's Kg/Ha	1's Kg/Ha

## **PRODUCT DETAILS**

- **GENERIC NAME:** FORTIFIED GYPSUM
- **BRAND NAME:** ZYPMITE

## **PRODUCT CONCEPT**

- COST EFFECTIVE MICRONUTRIENT SOLUTION.
- GENERIC PRODUCT SUITABLE FOR MOST CROPS UNDER DIFFERENT AGRO-CLIMATIC CONDITIONS.
- PARTLY SATISFY MICRONUTRIENT REQUIREMENT OF A SPECIFIC CROP IN A SPECIFIC AGRO-CLIMATIC ZONE.

# NUTRIENT CONTENT IN FINISHED PRODUCT

Calcium: 20~22%

Sulphur: 14~16%

Magnesium: 2~3%

Zinc: 1.5~2.0%

Boron: ~0.1%



# OTHER REQUIREMENTS

- IMPROVE FLOW PROPERTIES
- PRODUCE UNIFORM MIXING OF INGREDIENTS
- REDUCE POSSIBILITY TO FORM CAKE
- INCREASE COMPRESSION PROPERTY

# TRIALS UNDERTAKEN BY AGRICULTURE UNIVERSITIES

University	State	Year
Orissa University of Agriculture and Technology,	Orissa	2008-09, 2009-10
Acharaya N.G.Ranga Agril. University,	Andhra Pradesh	2010-11
Bidhan Chandra Krishi Viswa Vidyalaya,	West Bengal	2010-11
Rajendra Agril.University,	Bihar	2010-11
GB Pant University of Agriculture & Technology,	Uttar Pradesh	2010-11
Indira Gandhi Krishi Vishwa Vidyalaya,	Chhtisgarh	2010-11

**Significant yield increase noticed in Orissa University of Agriculture and Technology & Acharaya N.G.Ranga Agril. University trials.**



# EXTENSIVE FIELD TRIALS

- AROUND 800 NOS. OF FARMER FIELD TRIALS UNDERTAKEN FOR 3 YEARS.
- OUT OF WHICH AROUND 300 ABANDONED FOR AGRO-CLIMATIC AND CULTURAL PRACTICES PROBLEM.
- OUT OF REST 500 IN MAJORITY OF CASES THERE WAS SIGNIFICANT YIELD INCREASE.

# PLANT



- RAW MATERIALS REQUIRED FOR PRODUCTION OF ZYPMITE ARE :
  - GYPSUM
  - DOLOMITE
  - ZINC SULPHATE
  - BORAX PENTAHYDRATE
  - 3-5% GRANULATING AID
- PLANT CAPACITY: 10 TPH



# PROCESS DESCRIPTION



Handling,  
Storage of raw  
materials



Paddle  
Mixer



Granulator



Dryer



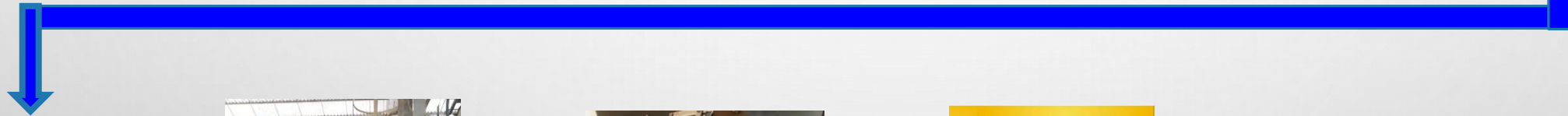
Cooler



Screen



Bagging



# PRODUCT SPECIFICATION

- MOISTURE : 4 – 5 %
- SIZE : 1MM TO 4MM (90% RETAIN ON 1MM SIEVE AND PASS THROUGH 4 MM SIEVE )
- CRUSHING STRENGTH : 0.5 – 1.0 KG FOR 3MM SIZE
- CALCIUM: 20~22%
- SULPHUR: 14~16%
- MAGNESIUM: 2~3%
- ZINC: 1.5~2.0%
- BORON: ~0.1%



***Thank You.....***

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