



Gainful Utilization of Stone Waste and Slurry



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Organizer CDOS

Report on Research Projects at MNIT Jaipur

MNIT Jaipur
CDOS Rajasthan



- **Center for Development of Stones (CDOS)**
- Build a Team with MNIT Jaipur, IIT Delhi, CSIR Roorkee, Small scale Industries association Rajasthan, builders and Industrialists dealing in stones, faculty members, students, Laboratory staff.

List of Research works Taken up at MNIT Jaipur

- **Civil Engineering Department** – Use of stone waste (Granite, Kota stone, Marble, sand stone) as building material, As soil stabilizer, as aggregate for low cost roads, as porous pavement material, as cold patching mix, as bituminous and cement concrete material for low lost local roads, as brick, block, tile making material (Concrete Lab, RMT Lab, Waste to Resources and Sustainable Materials lab, Material Research Center). (Industry and local government keen to resolve issue of waste disposal).
- **Mechanical Engineering Department** - Role of Stone Morphology and Microstructure on its Machinability Parameters for Reduction of its Waste Keeping Rajasthan Mined Stone as a Case, Innovative Magnetic Field Assisted Stone Cutter, Advanced Manufacturing & Mechatronics Laboratory.
- **Metallurgy Department** – Tribology laboratory- Deals in metal and stone alloy for making of blades for windmills, turbines, dental material.

Kota Stone...

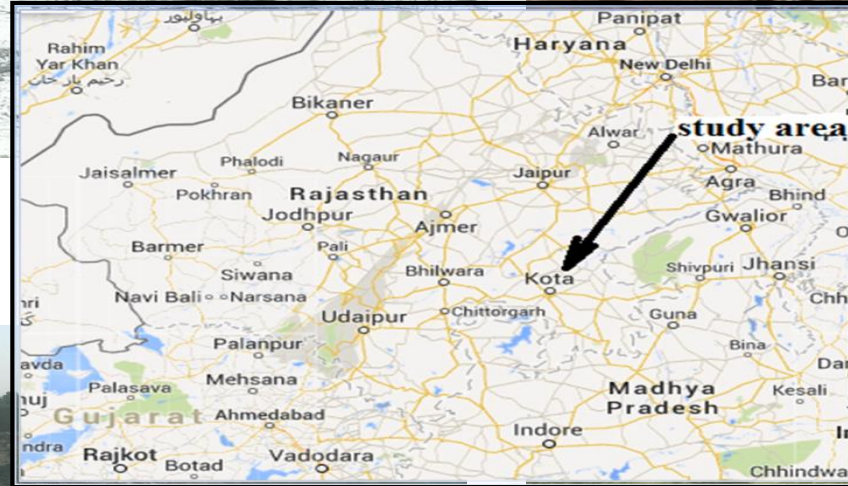
Kota Stone –Production – Solid and Slurry waste generation - Disposal problems – reformation of solid and slurry waste – Laboratory Investigation – Production of Reliable Building Materials (Bricks/Blocks/Tiles/Cubes, Beams, Flexible and rigid pavement material).



Kota stone slurry and affected vegetation



Deposits of kota stone waste



Deposits of kota stone waste near a water body



Deposits of kota stone waste along the Jhalwar-Ramganj Mandi highway

Kota Stone...

Kota stone is one of the types of dimensional flaggy limestone which is available in eastern Rajasthan of India at Chittor, Ramganj Mandi, Kota and Jhalawar district, with an annual production of around 17 million tons (Report, Centre for development of stones 2011).

Its deposits are located with an area of approximately 150 square km.

This is sedimentary nature rock having fine-grained siliceous calcium carbonate compositions. Physically this is compressed, hard, oil impervious, less water absorbent and non-slippery homogenous natural stone.

It is found in different colors blue, green, brown or their combinations

Kota Stone....

The mining of Kota stone has posed a serious threat to the regional environment, due to the disposal of huge quantity of solid and slurry waste.

Cutting and polishing of Kota stone produce around 10 Mt of waste each year (Kumar and Lakhani, 2017).

The mining and processing operations generate different types of waste such as solid and semi-liquid (slurry or powder) waste.

Production and waste data....

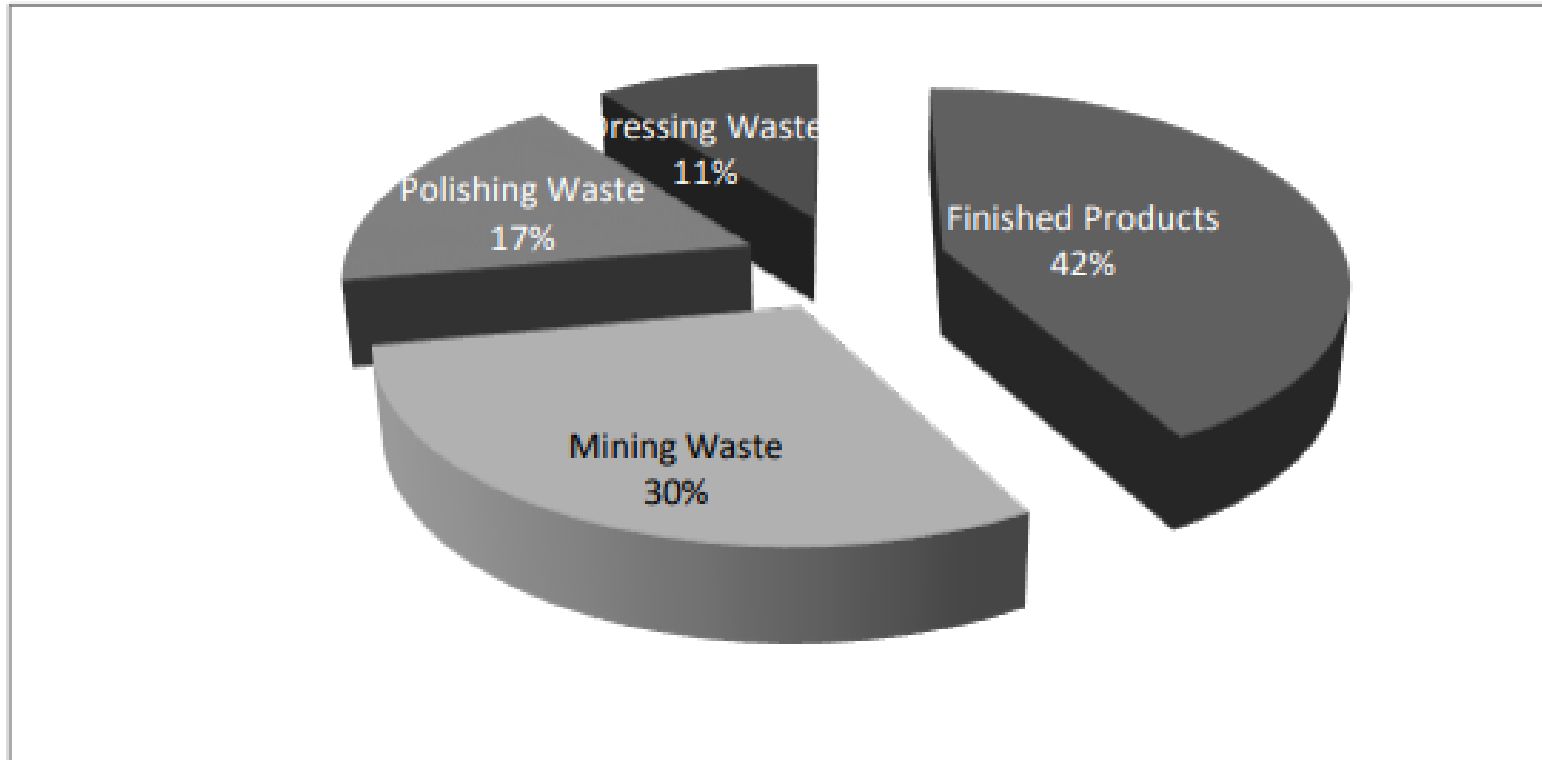


Figure Proportion of different types of stone waste generated and finished products obtained from a raw mined out stone (Source: Department of Mines and Geology, Rajasthan, 2001)

Kota Stone...



Kota Stone.....



- **Rajasthan, holds the largest share in the Indian stone industry.**
- **It holds vast reserves of stones like marble, sandstone, granite, limestone that fuel the state's economy.**
- **Industry is not making profits (ref. Meeting with Ramgang Mandi area small scale industries associations (14.07.15), Stone Mart 2017, Technical Seccession 03.02.17)**

Disposal of Stone waste

Kota-stone waste discharged into landfills.

Unorganized and illegal dumping of stone waste on fertile land or along roadside resulted in extensive land degradation, hindrance of the natural drainage system and damages the landscape of the region.

An estimated waste of more than 100 Mt is dumped on fertile land over a length of 35 km along the highway.

The National Green Tribunal has ordered 900 mines to shut their operations as they failed to obtain environmental clearance from the government.

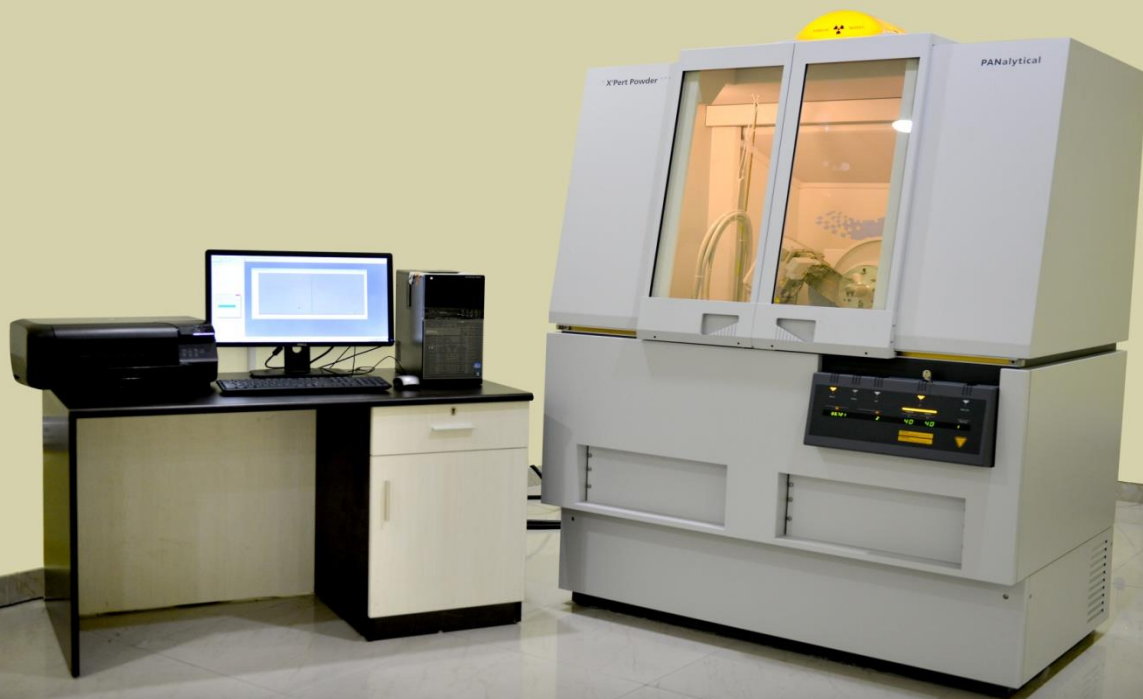
It is estimated that closure of these mines is resulting in loss of 100 million rupees/d and has unemployed around 50000 workers.

MATERIALS RESEARCH CENTRE



15th May, 2015

Equipment at MRC



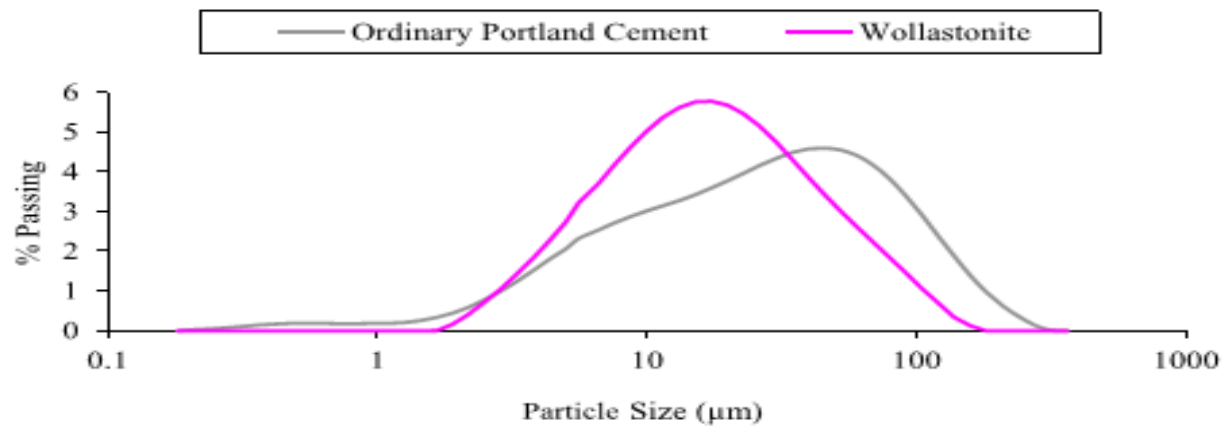


Fig. 3. Particle size analysis of wollastonite and cement particles.

Particle Size Analyzer



X-Ray Diffractometer

Applications:

- Determination of crystal structure
- Phase crystallinity, Bragg's plane, particle size
- Quantitative texture analysis
- Preferred orientation studies
- Reflection topography etc



Projects (Kota stone waste) at Department of Civil Engineering

Aditya Rana (2016), Mechanical and durability properties of concrete prepared with Kota stone coarse and fine aggregate were investigated.

Concrete mixes were evaluated for strength, durability parameters such as permeability, alkali-silica reaction, carbonation, acid resistance, abrasion, chloride penetration and corrosion. The results were validated with micro structural analysis such as SEM, TGA, MIP and Ultra sonic pulse velocity.

The results suggested that the Kota-stone coarse aggregates can be suitably utilized as a substitute of conventional coarse aggregates in normal and low strength concretes.

Pradeep Kumar Gautam (2018), Kota stone waste (as slurry (KSS) and as aggregate (KSA)) was evaluated as pavement material.

Ten soil samples prepared by replacing black cotton soil (BCS) with KSS between 2.5- 20%.

KSA was evaluated as granular sub-base (GSB) and bituminous (Dense bituminous macadam, Bituminous concrete and Open-graded friction course) course material.

On the basis of mechanical and durability properties of mixes such as Marshall quotient, indirect tensile strength test, tensile strength ratio, resilient modulus, dynamic creep, Cantabro, aged Cantabro, permeability and drain down test.

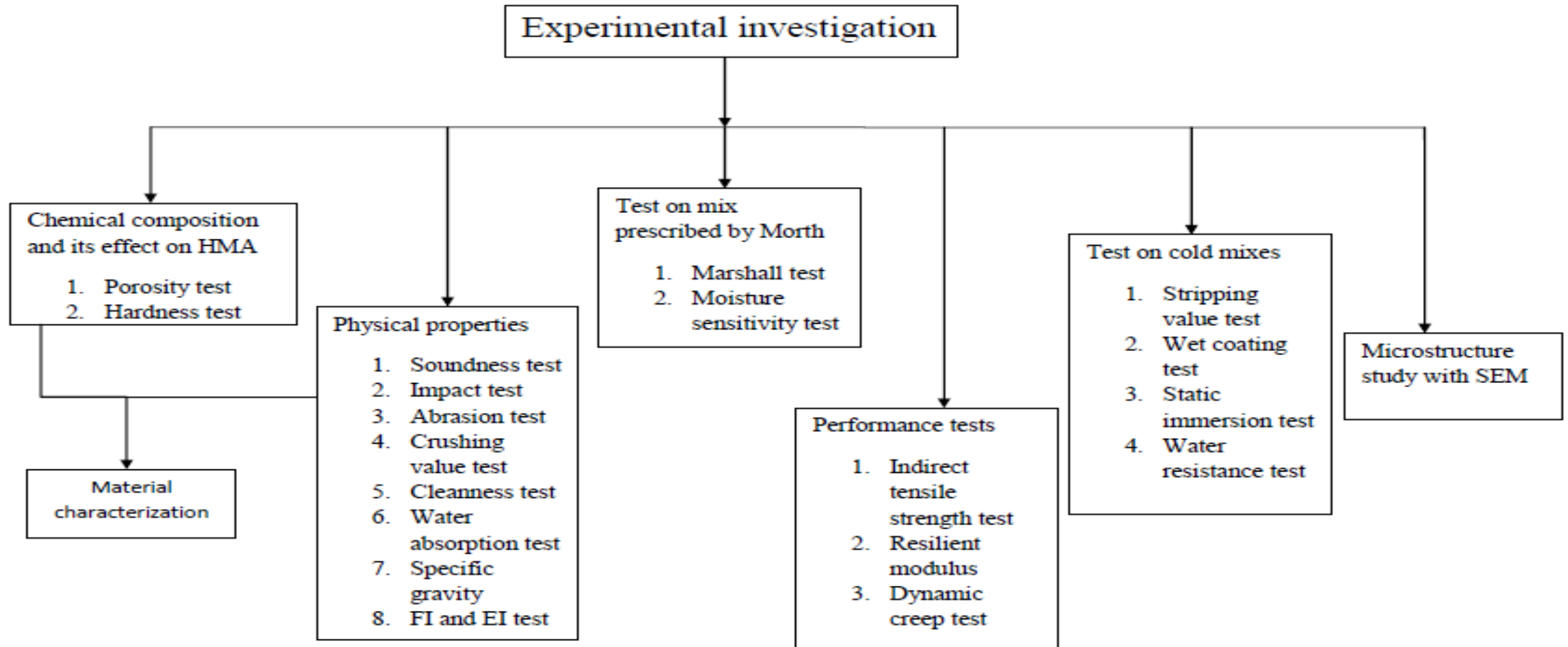
Kota stone slurry was found suitable as soil stabilizer when replaced in black cotton soil between 17.5-19%. Study also found suitability of KSA (up to 25-50%) in hot mix asphalt.

Harshwardhan Singh Chouhan (2019), Utilization of Kota stone waste as replacement of conventional river sand in mortar mixes.

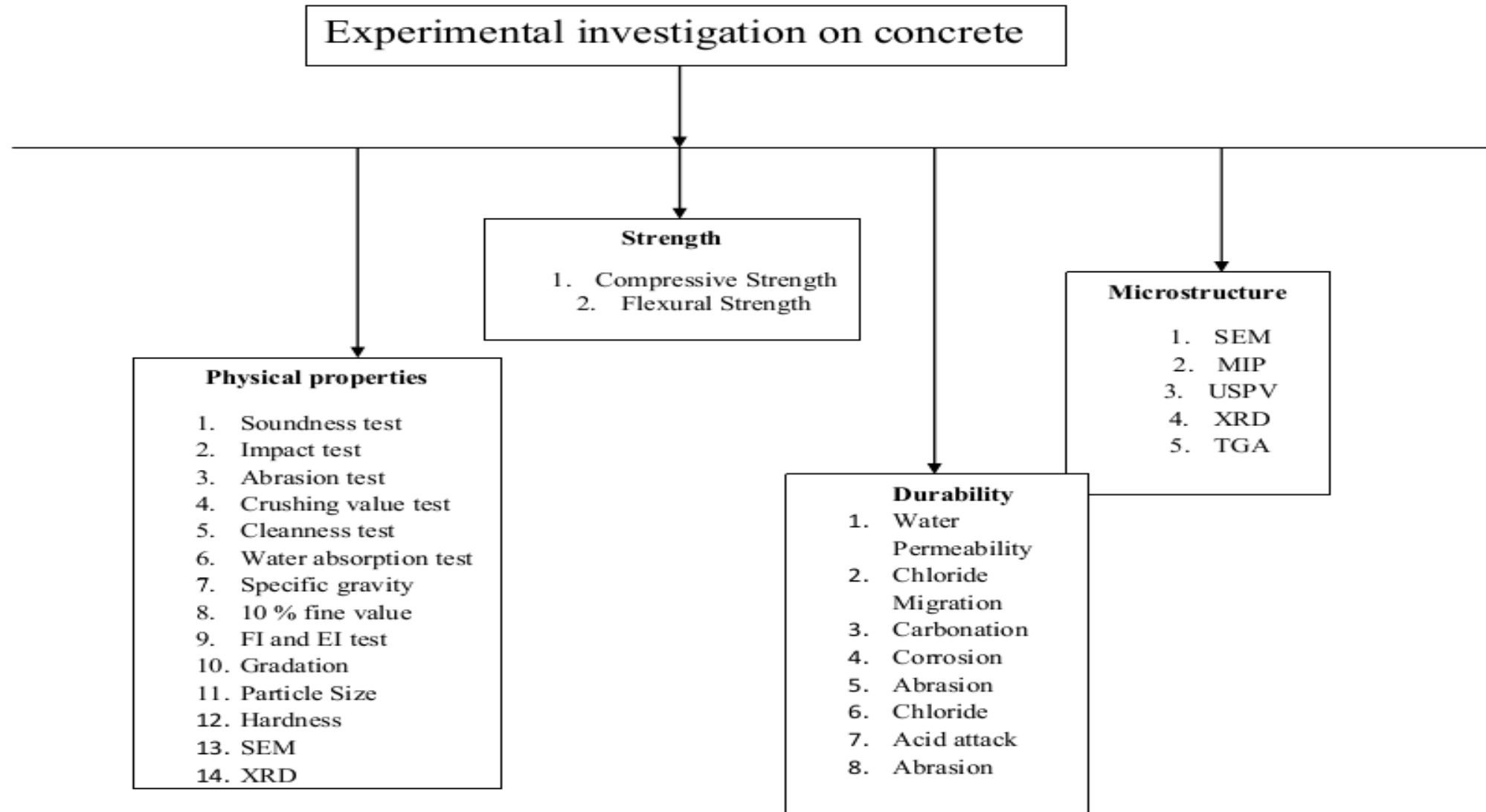
1:3, 1:4 and 1:6, were used and evaluated for their mechanical and durability properties such as workability, strength (compressive, flexural, tensile, adhesive), shrinkage, acid attack, sulphate attack, carbonation and chloride ion penetration.

20 to 40 percent replacement of river sand with Kota stone slurry improved strength, durability and sustained necessary rheological parameters of mortar mixes.

Bituminous Mixes



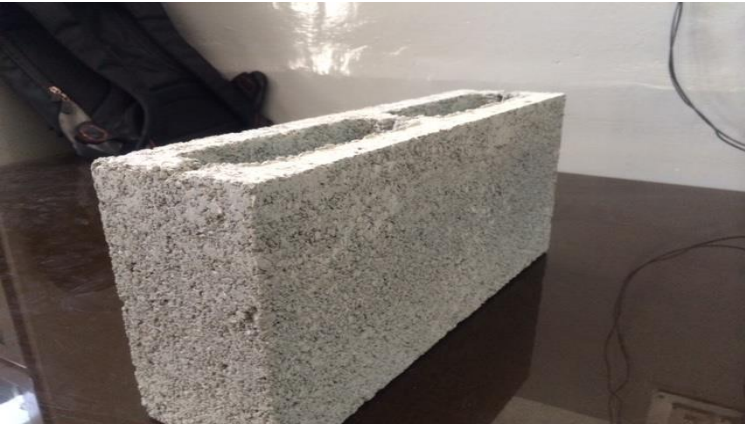
Concrete Mixes.....



Applications

- Investigations on Stone Waste as flexible and rigid material.
- Stone waste - Soil stabilization, as aggregate for bituminous, Cold Patching mix, OGFC (open graded friction course) cement concrete, tiles, bricks, blocks, material.
- Use of stone waste – **Reduce** pollution, save environment, reduce use of natural resources.
- Dumping yards free from debris available for development.
- Stone waste can be **Reused/ reformed/Recycled** for making material of low cost.

Proposed solution as products from Stone waste ...





• **Path way** from VLTC to Orbindo Hostel (600 m) Inter locking tiles made by waste stone at Waste to Resource and Sustainable Materials Laboratory, Department of Civil Engineering, MNIT Jaipur

Knowledge Sharing

Publications, Patents, Lectures, Seminars, Project Writing, media

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Gainful Utilization of stone waste and slurry Provide Solution to the problems of this Industry

- Use of stone waste – Reduce use of natural resources.
- Stone waste can be Reused as building material for low cost roads and housing.
- Stone waste available in the vicinity of mining and processing units ranging from very fine particles to big boulders can be reformed/Recycled.
- Adopting Zero waste project proposal for stone industry may lead to **Profits for Stone Industry**.
- It is suggested that Central - State government and Industries association jointly take initiatives.
- Immediate instruction by government agencies to utilize stone waste for making of Pradhan Mantri Gramin Sadak Yojana and Gramin Gaurav path.

Publications

Pradeep Kumar Gautam , Pawan Kalla, Ajay Singh Jethoo, Rahul Agrawal, Harshwardhan Singh **Sustainable use of waste in flexible pavement: Construction and Building Materials** 180 (2018) 239– 253.

H.S. Chouhan, P. Kalla, R. Nagar, P.K. Gautam, “**Gainful utilization of dimensional limestone waste as fine aggregate in cement mortar mixes,**” **Construction and Building Material** (2019).(Published) (Sci)

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धन्यवाद

Thank You All 😊