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# A Survey on Production of Bricks from Industrial Wastes

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**ABSTRACT:** In contemporary scenarios, there is a voluminous environmental concern in developing countries because of aggregation of unmanaged industrial wastes. This industrial wastes leads to environmental pollution problems. Industrial waste may be solid, liquid or gaseous. It may be hazardous or non-hazardous waste. Hazardous waste may be toxic, ignitable, corrosive, reactive, or radioactive. To overcome pollution issues, such wastes need to be recycled in the form of construction material. This manuscript reviews several waste materials in divergent mixtures, which are added to raw material at distinct levels for producing new bricks. Several thermal & mechanical properties of bricks including diverse waste materials are studied and suggestions are made as a result of this contribution. The method reviewed for producing and designing a new bricks by utilizing industrial wastes is a resourceful solution for reducing the pollution and making an optimal design of green buildings.

**KEYWORDS:** Bricks, Industrial wastes.

## I. INTRODUCTION

One of the most important building materials is brick, which is used for making pavements, walls & other components in masonry construction. Conventionally, brick signifies as clay composed unit. However, now it is used for indicating rectangular units from lime, concrete, sand, & soil materials. Bricks could be integrated together using adhesives, mortar or by interlocking. Here, bricks are generated in several types, sizes, classes & materials that might change with time period & region. They were generated in voluminous quantities.

The traditional model of making bricks left this as significant aloof material in the advancement. Here, infrastructure like buildings for industry & housing, and facilities to handle sewage & water might need huge amounts of materials for construction. The work [1] [2] presents that bricks production in world-wide is approximately 1391 billion units & more demand for the bricks is expected. As huge demand is placed on industry building construction material in past decade, there could be a mismatch among supply of these materials as per demand. Therefore, in order to meet the enhancing demand continuously, the researchers are trying to develop & design sustainable alternate solutions towards construction material. Many endeavours are made for including waste in bricks formation; in case, utilization of paper residues processing, fly-ash, straw, cotton waste, polystyrene fabric, plastic fiber & dried sludge were gathered from limestone dust, granulated slag of blast furnace, production residue of Kraft pulp, wood sawdust, slag of welding flux & pulp of waste paper [3-16]. This manuscript presents review on use of divergent waste materials types for making bricks. The merits & demerits of divergent models to utilize waste materials for bricks generation are explained.

## II. REVIEW OF LITERATURE

In this section, an extensive research is carried out on waste materials usage for making or creating bricks. The work [3] presents that possible utilization of combination of concrete & crumb rubber to produce lightweight & less cost composite brick with enhanced thermal resistance is examined.

The work [4] presents that possible utilization of waste tea processed in the clay bricks is investigated. The impacts of addition of processed material of waste tea on mechanical & durability bricks properties are examined. This is because of waste tea processed organic nature, binding capability; pore-forming in body of clay is examined. Primarily, the PWT material is isolated in water for about 24 hours. Later, in order to attain comparable outcomes, distinct waste ratios are added for raw-brick clay.

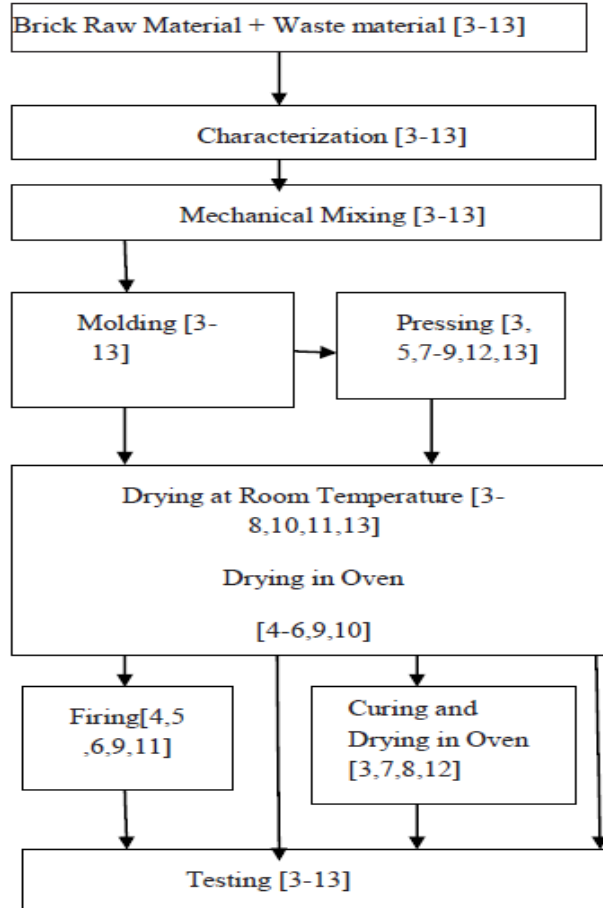


Fig. 1. Methodology followed for manufacturing waste-crete bricks.

The work [5] presents that lightweight bricks & porous are developed with lessened thermal conductivity & attainable compressive strength through utilizing residues of paper processing in the form of additive for earthenware brick to generate pores. The chemical examination of waste paper & raw material of brick is performed. The mixtures comprising of raw materials of brick and waste paper is prepared at divergent proportions. The powder granulated mixtures are compacted in hydraulic press also green bodies are dried before firing at the 1100C. The work [6] presented that from the dried sludge, the bricks are gathered from waste industrial material. As needed by CNS benchmarks for constructing bricks, the generated bricks undergo a sequence of tests comprising absorption of water, compressive strength, ignition weight loss, & bulk density for determining bricks quality.

The work [7] presents parametric simulation study that examines the possible utilization of combination of waste of lime powder & cotton to produce novel light weight & loss cost composite in the form of building-material. Here, the mechanical & physical bricks properties having maximum level of waste of lime powder & cotton are examined. The work [8] presents the parametric simulation study that examines the possible utilization of wastage of limestone powder, wastage of wood sawdust combination to generate lightweight & low cost composite in the form of building material. Here, some of mechanical & physical concrete properties are possessing maximum level of wastage of limestone powder & wastage of wood sawdust are examined. Here, the attained flexural strength, water absorption, compressive strength & unit weight values satisfy associated international benchmarks. The work [9] examined the probable utilization of recycled welding flux slag in construction. The welding flux slag is examined in the form of an alternative for the production of sand in manifold utilization of clay & mortars to generate ceramic bricks. Here, ceramic pieces are prepared by comprising kaolinitic clay sedimentary approximately 10% by SWF weight. Here, the pieces are made through uniaxial pressing & fired at the 950 C. Here, after firing several properties determined are absorption of water, flexural strength, linear shrinkage & apparent density.



The work [10] formed bricks from mixture of clay and sand with divergent percentages of rice burnt & husk ash in furnace for divergent times of firing. The duration of firing at 1000C are 2, 4, 6 hours. The impacts of ash contents of rice husk on workable water content mixing, density, absorption of water, compressive strength of bricks are examined. The work [11] conducted simulations in laboratory for lessening soil consumption in bricks through adding fly-ash & examined the fly-ash impact on bricks properties. Divergent fly-ash proportions & distinct baking temperatures are endeavored for examining their impacts on water absorption & compressive strength of bricks. The work [12] presents that fly-ash lime gypsum production of bricks & hollow blocks for solving housing shortage issues and at similar time for building houses by using wastes from industrial. The work [13] examined bricks production from granulated slag of blast furnace, the byproduct of steel industry & iron. Contemporarily, the chemical & physical slag properties are conducted. The contribution reveals best quality bricks that could be generated from the mixture of sand & slag-lime by pressing compact at 50kg /cm<sup>2</sup> pressure. Here, bricks are tested to compress strength, absorption of water, & bulk density properties.

Table 1 Design & Development of bricks

Ref .No	Utilization of Waste material for formation of brick & % utilized (by weight)	Brick mould size(mm)	Drying	Firing	Several tests carried
3	Crumb rubberwaste,10%	105 * 100*75	Dried for 6 h at aroom temperatur e.	It has been fired for the 28 days and later died over 48h at temperature of 65 in the oven.	Water Absorption, Compressive strength, UPV test, splitting &flexural strength test.
4	5% of Wastetea	40 * 70*100	Dried at a temperature of 21 _C for 72 h Later, dried at temperature of 105 in oven	Fired at rate of2 <sup>o</sup> C/min until 600 _C & then 5 <sup>o</sup> C/min until 900 _C over 2 h.	Compressive strength, water-absorption, density
5	10% of Paper processing residues,	85 *85 *10	Dried at 45 _C for 1 h in an oven	Fired in a furnace at 2.5 <sup>o</sup> C/min until 600 <sup>o</sup> C, &later at rate of 10 <sup>o</sup> C/ min until 1100 <sup>o</sup> C, for 1 h.	Thermal conductivity, Compressive strength, water-absorption, density
6	10% Dried sludge gathered from an waste water industrial treatment plant	230 *110 * 60	Dried at 103 temperature over 24 h in oven	Fired in combustion chamber at 880-1000 <sup>o</sup> C	Compressive strength, water-absorption, density
7	10% of Cotton waste (CW)–lime by volume	105 *90 *75	Dried at room temperature for 24 h	Cured in tank filled with lime-saturated water at 22 <sup>o</sup> C for 28 days	UPV test, Compressive strength, water-absorption, density
8	15% of Limestone & sawdust,	105 *90 *75	Dried for 24 h at a room temperature	Cured for 28 days in then dried for 24 h at temperature of 105 in oven	UPV test, Compressive strength, water-absorption, density
9	5% of Welding flux slag	115 * 254 (cylindrical	Dried at 110 _C for 24 h	Fired in fumace at temperature of 950 <sup>o</sup> C	Compressive strength, water-absorption,





		piece)	in an oven	for 2 h.	density
10	20% of Rice husk ash	50 *50 *50	Dried at a temperature of 105 for 24 h in oven	Fired in furnace at temperature of 1000°C.	Compressive strength, water-absorption, density
11	20% of Fly ash,	95 *45 *40	Dried at temp 24 h.	Fired in furnace at 800°C & 1000° C	Compressive strength, water-absorption, density
12	Fly ash–lime–gypsum (60, 10, 30%)	220 *100 *75	–	Cured in water filled curing tanks at 23.2 °C	Compressive strength, water-absorption, density
13	50% of Granulated furnace slag blast	190 * 90 *90	–	Cured at 95% humidity and at a temperature of 27 °C over a period of 28 days.	Compressive strength, water-absorption, density

Table 2 Compressive strength of WCB made from various industrial solid waste

Waste material	Compressive strength (N/mm2)
Crumb rubber waste	20
Waste tea	22.5
Paper processing residues	23
Dried sludge	21
Cotton waste –lime powder waste	16
Limestone and sawdust	16
Rice husk ash	15.8
Fly ash	17.5
Fly ash–lime–gypsum	7
Granulated blast furnace slag	14.8

Table 3 Water absorption of WCB made from various industrial solid wastes

Waste material	Water absorption(%)
Crumb rubber waste	4
Waste tea	10
Paper processing residues	23
Dried sludge	7
Cotton waste –lime powder waste	20
Limestone and sawdust	13
Welding flux slag	20
Rice husk ash	19
Fly ash	13
Fly ash–lime–gypsum	28
Granulated blast furnace slag	8

### III. DISCUSSION

It is obvious that researchers utilized several materials of waste in divergent ratios and also several techniques are adopted for generating bricks. Here, the model to generate bricks from materials of waste through firing could be same to traditional clay brick generation procedure. Hence, this model could be performed easily deprived of making major variations in traditional production line of clay brick. Nevertheless, at the time of firing procedure, the contaminants within waste might release and cause novel contaminations. Also, creating bricks by firing consumes prominent energy quantity and release huge amount of greenhouse-gases. Hence, the models to generate bricks deprived of firing follow trend in environmental & energy concerns. The most common factors computed by several researchers are compressive strength & water absorption. The suggested minimum values or compressive strength aimed at load & non-load bearing solid clay fired bricks are 5-10Mpa & 3-5Mpa in respective order [14] [15]. As per the classification, less brick compressive strength could be 3.5 N/mm<sup>2</sup>.

### IV. CONCLUSION

On the basis of review of several researches on bricks formation from waste, the succeeding conclusions are made: an extensive type of wastage materials are researched for bricks formation. The potential reasons are associated to models for forming bricks from waste, the possible contamination from wastage materials are utilized, related standards are absent, and slow waste materials acceptance based bricks through public & industry. Over an extensive production & bricks utilization from wastage materials, here, this research and improvement is required, not only economic, environmental & technical factors yet also on public education, policy of government, standardization. Several techniques for planning & developing of bricks formation has reviewed. Several chemical & physic-mechanical properties of bricks including distinct wastage materials are researched as per standards & reviewed standards. The performance is augmented in attaining lighter density, less thermal conductivity & maximum compressive-strength of several waste bricks provides an economical choice for designing green or pollution less building. This contribution is also resourceful for several resource persons included in utilizing agricultural or industrial waste material for improving maintainable construction material.



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