ISSN: 0973-4929, Vol. 19, No. (**2**) 2024, Pg. 545-557

Current World Environment

www.cwejournal.org

Exploring the Utilization of Municipal Solid Waste in Sustainable Construction Materials

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Abstract

Municipal solid waste (MSW) is a growing problem worldwide, as populations increase, and consumption patterns change. It not only causes pollution and health hazards, but it also results in the depletion of resources. Considering this, the utilization of MSW in sustainable construction materials has become a critical area of research. The purpose of this review study is to explore the various ways in which MSW can be utilized in sustainable construction materials such as fired clay bricks, eco-cement, geo-polymer, fly ash (FA), bottom ash (BA), ceramic bricks, municipal solid waste incineration (MSWI), incineration bottom ash (IBA), and coal bottom ash (CBA). This article also helps to understand the properties of waste-based materials and the potential for their use in various applications. This information renders the construction sector to design and develop standard guidelines for the use of waste-based materials. The significance of this review article lies in its potential to transform the construction sector into a more sustainable and resource efficient sector by leveraging the resources that are already available. Integrating waste into construction materials not only averts the waste from landfills and incinerators, but also facilitates the necessity of raw materials and consequently sustains the natural resources. Additionally, the utilization of waste-based building materials can lead to a reduction in the carbon trace of the construction industry, as waste materials often have lower embodied energy compared to traditional building materials. The outcomes of this review will provide valuable insights into the potential of MSW as a resource in sustainable construction and contribute to the development of effective Municipal Solid Waste Management (MSWM) strategies.

Article History
Received: 16 January 2024
Accepted: 15 June 2024

Keywords
Durability; Environment; Municipal solid waste (MSW); Strength; Sustainable Construction Materials.

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Doi: https://dx.doi.org/10.12944/CWE.19.2.4

Introduction

Municipal solid waste (MSW) is a growing problem worldwide, as populations increase, and consumption patterns change. The disposal of MSW has significant environmental and economic impacts, and it is becoming increasingly important to find sustainable solutions for managing this waste. One potential solution is the utilization of MSW as sustainable construction materials.[1] Sustainable construction materials are defined as materials that are produced, used, and disposed of technically that minimizes their environmental impact and maximizes their social and economic benefits. The use of MSW in construction materials can help to reduce the volume of waste dumped in landfills, subdued greenhouse gas releases, and safeguard natural resources.[2] Furthermore, it can also be cost-effective and contribute to local economic development. In recent years, there has been a breeding curiosity in the utilization of MSW in sustainable construction materials, as researchers and practitioners explore new ways to turn waste into valuable resources. This review paper aims to summarize and evaluate existing research on the utilization of MSW in production of fired clay bricks, eco-cement, geo-polymer, ceramic bricks, fly ash (FA), bottom ash (BA), incineration fly ash (IFA), incineration bottom ash (IBA) and coal bottom ash (CBA).[3] The paper will also provide an outline of the challenges and opportunities for future research and advancement in this field. It is important to note that research on this topic is still evolving, and new studies and projects are constantly being developed. Therefore, this review paper will focus on the most recent and relevant literature, with a knowledge cutoff of 2022.

MSW in Sustainable Construction Materials

MSWI residue can be used to manufacture fired clay bricks and eco-cement. MSWI residues are degraded and are one of the components used for the fabrication of fired bricks. FA and BA wastes from MSWI are used in the fabrication of ecological clay bricks. The waste produced by thermoelectric power plants is also used in the manufacture of Fly Ash bricks. Cement produced by the MSWI is not at all inferior to traditional Portland cement. IBA can be used as a cement supplement. Rice Husk Ash, Coal Fly Ash, and Municipal Solid Incineration Ash may be used to produce Geo Polymer Binder as green construction materials. MSWI Bottom Ash, like CBA can additionally be benefitted as a supplement of fine aggregate in cement concrete. It has a very good quantity of silica and has a very good pozzolanic property. MSWI, Fly Ash may also be used for the fabrication of ceramic bricks, modified wall blocks, etc. which are eco-friendly. Environmental pollution generated by MSWI can be controlled by utilizing the MSWI Fly Ash, a sustainable construction raw material. Utilization of by-products of MSW provides a viable alternative to MSWM and contributes to preserving the natural resources of construction materials. MSW plastic bottles and rubber tyres can be employed as partial replacement in bitumen concrete mix which can facilitate in meeting the bitumen challenge in road construction.[4,5] Rice husks-plastics composites can be used as sheathing roof materials, concrete placing, and interior wall panels due to its competent flexural strength, dimensional stability, and efficient water resistance.[6] Moreover, rice husk ash (RHA) can also be benefitted as a fine aggregate instead of sand in fabricating autoclaved aerated concrete (AAC).[7] The workability of the waste plastic concrete mixes can by enhanced by mixing 10 to 15% superplasticizer.[8] Addition of high-density polyethylene (HDPE) with cement increases the ductility and workability whereas decreases the density of plastic bricks.[9] The compressive and flexural strength of AAC is observed to be increased by 43.9% and 42.8% respectively when 1.5% of Poly-carboxylic admixture was mixed.[10] MSW incineration bottom ash has been utilized as aerating agent and as source of silica in place of aluminum powder and silica fly/flour ash to manufacture AAC.[11] Wood fiber produced from wood waste can be used in AAC to increase flexural strength.[12] Incorporation of waste fiber reinforced polymer powder (FRP) as a substitute of fine aggregate in concrete increases the strength whereas reduces the workability.[13] Sodium carbonate activated slag has replaced cement in AAC identified as alkali activated autoclaved aerated concrete (ASAAC) with improved performance in terms of strength development, drying shrinkage, porosity, environmental impact, and cost.[14]

In a finding by Smith *et al.*[15] the authors investigated the use of MSW-derived fly ash as a partial substitute of cement in making concrete. The study found that the fly ash significantly improved the durability and strength of the concrete, with no negative impact on its workability or setting time. The authors also implemented a life cycle assessment and observed that the use of fly ash in concrete resulted in a substantial saving in greenhouse gas emissions compared to traditional cement production. This study highlights the capacity of MSW-derived fly ash as a valued resource for sustainable construction materials. The results indicate that fly ash can upgrade the performance of concrete while reducing its environmental impact. Furthermore, the life cycle assessment provides beneficial evidence on the sustainability of this application of MSW. Related studies[16,17,18] have also been reported investigating the use of MSW-derived fly ash as a replacement for cement in concrete. Also, they evaluated the performance and sustainability of concrete in relation to strength, durability, and environmental impact.

In research presented by Wang *et al.,*[19] the authors explored the use of MSW-derived waste as a replacement for aggregate in asphalt pavement. The study found that plastic waste substantially improved the thermal stability and fatigue resistance of the asphalt, while also reducing its cost. The authors also conducted a life cycle assessment and found that the use of plastic waste in asphalt resulted in a reduction in the use of natural resources and greenhouse gas emissions. This study highlights the potential of MSW-derived plastic waste as a valuable resource for sustainable construction materials. The results indicate that plastic waste can increase the performance of asphalt while reducing its environmental impact and cost. Furthermore, the study's life cycle assessment provides valuable information on the sustainability of this application of MSW. Ikechukwu & Shabangu[20] investigated the application of crushed glass and melted PET (polyethylene terephthalate) plastics as partial replacements for traditional aggregates in masonry brick production. Kazmi *et al.*[21] established an economical and sustainable method for mass-scale construction of burnt clay bricks by addition of RHA and SBA up to 5%. Sahu *et al.*[22] proposed the optimum proportion formula for the fabrication of environmentally friendly brick using processed tea waste (PTW) and water treatment plant (WTP) sludge. The compressive strength and thermal insulation property of clay bricks can be improved by mixing 5% PTW, 40% WTPS, and 55% natural clayey soil. Vasudevan *et al.*[23] demonstrated the use of waste plastics in construction of flexible pavements where it was concluded that coating of polymers and plastics on aggregate enhances the characteristic of aggregate and helps to reduce the equivalent quantity of bitumen required. Ikechukwu & Shabangu[24] concluded the bricks yielded from foundry sand (FS) and scrap plastic waste (SPW) have 85% greater strength as compared to fired clay bricks. Lamba *et al.*[25] reviewed the use of recycled plastic waste as a construction material. Akinwumi *et al.*[26] investigated the manufacturing of compressed earth bricks made using a mixture of soil and 1% shredded waste plastic (size <6.3 mm) and observed a 244% enhancement in the compressive strength. Alaloul *et al.*[27] demonstrated that PET can be incorporated with polyurethane (PU) in 60/40 ratio for building non-load bearing masonry brick partition walls. The utilization of plastic waste as construction material will not only resolve the problem of solid waste management but will also monitor the rate of depletion of natural raw materials employed in construction. In addition, it will also assist the sustainability trend of a circular economy.[8,28,29,30,31,32] Azhdarpour *et al.*[33] and Hossain *et al.*34 observed an increase in compressive, tensile and flexural strength of concrete with addition of 5-10% PET fragments in concrete against partial replacement of fine aggregates. Hameed *et al.*[35] presented the result where 1% use of PET increases the compressive and flexural strength by 58% and 23.11% respectively. In Recycled plastic aggregate concrete, thermal conductivity reduces with increase in the quantity of RPA and are therefore used as effective thermal insulation materials.[36,37,38] Mixing of 0% to 2% metalized plastic waste fibres in concrete by volume reinforces the tensile strength and ductility of concrete.[39,40] Jahidul and Shahjalal[41] proposed the performances of concrete by incorporating polypropylene plastic aggregate as partial replacement of burnt clay brick aggregate and natural stone aggregate. They suggested using up to 10% polypropylene plastic aggregate either with brick aggregate or stone aggregate to achieve concrete having strength 25 MPa and w/c of 0.45. Da Silva *et al.*[42] reviews the consumption of plastic waste as a construction raw material and assesses its impact using the concept of life-cycle assessment (LCA). Jethy *et al.*[43] briefly reviewed the properties, evolution, and utilization of plastic waste in construction. Mohan *et al.*[44] presents a proposal for using Personal Protective Equipment (PPE) biomedical waste as a resource in the construction sector. Studies[45,46,47] also investigated the use of different types of MSW-derived materials in sustainable construction materials, including plastic waste, fine powder, and construction and demolition waste. Vargas *et al.*[48] examine the various methods used to manage and reduce solid waste generated by construction activities, such as recycling, reuse, and waste-to-energy. Miraldo *et al.*[49] discussed the use of recycled waste materials, such as glass, ceramics, and demolition waste, as aggregates in making structural concrete. Mohammed *et al.*[50] proposed different methods like carbonation and pozzolan slurry to improve the properties of construction and demolition waste derived aggregate called recycled concrete aggregate. Few studies[51,52] conducted in Melbourne's Eastern Treatment Plant biosolids in fired clay bricks which helped in saving 25% energy during firing in furnace. Moreover, he suggested the addition of biosolids of up to 25% in non-load bearing fired-clay bricks and for high-quality bricks the percentage should be decreased. Wolff *et al.*[53] proposed the use of water treatment plant (WTP) sludge as a substitute for clay in formulation of clay masses to produce acoustic bricks or interior coatings. Villarejo *et al.*[54] concluded the use of 20 weight% biomass incinerator ashes in ceramic formulations to produce ceramic bricks meeting the UNE standards compressive strength. Bodes *et al.*[55] demonstrated the use of agricultural biomass wastes for production of fired clay bricks and concluded 4% (by weight) incorporation of sunflower seed cake with minimal crushing gives optimal mechanical and thermal results. Ma *et al.*[56] exploited the use of iron tailings in the fabrication of autoclaved aerated concrete (AAC) and presented the technological parameters for its preparation. Azevedo *et al.*[57] presented the potential use of paper industry sludge for the manufacturing of cement and ceramic-based materials because of the presence of CaO in high concentrations. Further it's also confirmed that the incorporation of 10% sludge in manufacturing of soil-cement locking blocks meets all the requirements of compressive, water absorption and durability tests. Fan *et al.*[58] synthesized glass-ceramics by incorporating MSWI fly ash for the solidification of heavy metals and waste recycling. Ghourchian *et al.*[59] identified the process of solving the plastic shrinkage cracking issue in concrete by adding fine fillers like silica fumes. Gyurko *et al.*[60] presented the possibilities of recycled autoclaved aerated concrete (AAC) as concrete aggregate, concrete blocks, prefabricated concrete tiles and shuttering blocks. Karayannis *et al.*[61] investigated the ceramics made using mixture of waste glass cullet (WGC) and 100% lignite fly ash (FA). Leiva *et al.*[62] presented an optimal firing temperature for bricks of about 1000 0C for maximum replacement (approx. 80%) of clay with fly ash. Ponsot *et al.*[63] demonstrated the likelihood of salvaging fly ash from MSWI for the development of glass-ceramic materials. Pedro *et al.*[64] explained the possibility of manufacturing aerated foamed concrete blocks by replacing sand with agate gemstone waste (containing SiO_2) also known as rolled powder.

Production of Sustainable Construction Materials from MSW

MSW can be used to produce fired clay bricks. Fired brick has been utilized as a construction material all over the world for a long time. It can be easily manufactured from the soil. Bricks also have some insulation properties. Agricultural soil is one of the main ingredients in the manufacturing of bricks which has a very bad effect on natural resources and the productivity of agricultural soil. So, there should be consideration for the conservation of natural soil by finding some sustainable construction materials. MSW may be used for manufacturing bricks which could be developed as a good sustainable construction material.[65] Brick manufactured by recycling various types of organic wastes have good properties viz.; water absorption, lightweight, and less energy consumed for the manufacturing process. Clay can be replaced for the manufacture of bricks with an environment-friendly construction material by using MSW.[66] The addition of fly ash cenospheres improves structural integrity of tiles.[67] Bottom ash from olive pomace can be used to replace 10-50% by weight of clay in manufacturing of bricks.[68] Bricks developed using bottom ash and fly ash show better strength, better durability, and low rate of suction.[69,70] Incorporation of glass waste enhances the physical as well as mechanical properties of fired clay bricks and lowers the firing temperature.[71] The addition of waste marble powder in certain ratios makes brick porous but also introduces crystalline phase during brick production.[72] Waste ferrochromium slag and zeolite can be used as construction material for brick manufacturing.[73] Thermal conductivity of fired clay bricks can be improved by using waste pomace from winery industry.[74] By-products of coal combustion of a thermoelectric power plant can be reused for the manufacture of fired clay bricks.[75] Bricks manufacturing using MSW may also grant a sustainable solution for the disposal of wastes and will also give relief to the agricultural soil.[66] Eco-cement can be produced by MSWI residues. FA, BA, and APC lime (air pollution control lime) are the main constituents of MSWI residues. Around 300 kg of BA and 30 kg of FA and APC lime are obtained after the incineration of one ton of MSW. Nowadays construction industries are using MSWI residues as building material. MSWI residues are also suitable for aggregation pavement construction, cementitious materials, and the production of cement clinker. MSWI Bottom ash is used as a replacement for aggregate in road construction and can be used as partial or complete alternative of raw materials for manufacturing of ceramic-based products.[75,76] APC lime and fly ash are also used in a concrete mix as a partial replacement for cement. A special type of cement produced from MSW incineration ash is known as Eco-cement which contains some amounts of chlorine compounds like calcium chloroaluminate.[77] Incineration of MSW is implemented for solid waste management by reducing the volume of waste.[78] The main constituent of incineration ash is bottom ash (80%) and fly ash (20%). A less leachable heavy metal is present in IFA and IBA. IBA contains less quantity of chloride as compared to the IFA. IBA is widely used to produce cement clinkers and aggregates in mortar preparation concrete mix and is also used in the base and the sub-base course for the construction of roads. It has some harmful effects on human healthiness and the ecosystem due to the presence of dioxins in MSWI fly ash (FA).[79] Copper (Cu), Calcium (Ca), Chromium (Cr), Lead (Pb), Nickel (Ni), and Zinc (Zn) are some heavy metals available in MSWI fly ash which are dangerous and hence are treated safely. However, MSWI fly ash also contains SiO_2, Al_2O_3, and CaO as reported by some researchers, and it may be used as cementitious material also.[80] Portland cement clinker is manufactured by recycling MSWI ash. The reaction of calcium, iron, aluminum, and silica oxides produces Portland cement clinker at very high temperatures. The four major compounds are formed viz., tricalcium silicate, aluminate, and tetra calcium alumino-ferrite. Calcium oxide, aluminum oxide, iron oxide, and silica oxides are available in high content in MSWI ash which makes as a good replacement for traditional raw materials to produce cement.[81] The combustion process is waste to energy plants produces the IBA as a by-product. IBA is stored outdoors for at least 2 to 3 months for carbonation and oxidation of IBA. The material available after the weathered process is known as weathering bottom ash (WBA). Glass-ceramics, stone, brick, concrete, and ash are available in WBA which has a grain size that almost matches the natural sand gravel. So, it is also used as a secondary aggregate in many countries for permanent construction.[82] MSWI fly ash can be replaced up to 30% of it was found as cement raw material otherwise it has a negative impact on compressive strength and increases the setting time also.[83] Washed MSWI BA may be used as the aggregate to produce concrete by replacement of natural aggregate for a better result. Grounded MSWI BA is also used for the production material for pavement construction.[84] Industrial wastes are also used to produce geopolymer binders as green construction materials.[85] Azad and Samarakoon[86] explore the utilization of waste materials and industrial by-products to create geopolymer cement and concrete. Kheimi *et al.*[87] review the use of waste material in the process of geopolymerization for heavy-duty applications. Environmental pollution is caused due to the main production of coal bottom ash (CBA) which is generated in several countries to generate electricity after coal burning. CBA impact is bad for human health and the environment causing skin and lung cancer etc. So, it may be used as sand replacement for making concrete to avoid the disposal of waste also.[88] Assessment of recovered MSWI sands may be used in concrete.[89] Fly ashes obtained from the combustion of municipal sewage sludge are also used in the production of ash concrete.[90] Bikila and Ighalo[91] investigated the use of wastepaper ash as an auxiliary cementitious material in C-25 concrete. Kizinievic *et al.*[92] investigated the impact of BA obtained from MSWI on the properties and frost resistance of clay bricks. This BA has also been utilized for the preparation of autoclaved aerated concrete.[93] In traditional concrete coal combustion bottom ash (CBA) can also be used as a micro-filler because it has pozzolanic properties.[94] Eco-friendly ceramics can be produced by utilising MSWI fly ash.[95] To produce autoclaved and modified wall blocks the MSWI fly ash can also be utilized.[96]

The sustainability of utilization of MSW for sustainable construction materials was studied by many researchers. A detailed summary has been compiled[97] based on the influence of fluxing oxides derived from waste on the production and physio-mechanical properties of fired clay brick. Another review was performed based on the progressive utilization possibilities of CBA. Muthusamy *et al.*[88] discussed the use of CBA as replacement of sand in the manufacturing of concrete. It has mentioned characteristics such as physical, and chemical workability, mechanical characteristics like- modulus of elasticity, compressive strength, flexural strength, and durability in terms of resistance to sulfate attack, resistance to acid attack, and application that are environment friendly.[89] This review paper focuses on the specific construction materials produced by the utilization of MSW.

Methods Adopted

Gaurav *et al.*[65] has used the laterite soil and alluvial soil with degraded MSW about 2 months old for making the fired bricks. The soil sample was mixed with degraded MSW. Then it was dried and ground up to 1mm. It was mixed in different ratios like 5%,10%, and 15% and 20% for the preparation of brick samples.[55] The researcher has collected the MSW incineration residue after the incineration process to produce eco-cement.[78] Geo polymer was produced by the researchers with the help of industrial wastes like Class C coal fly ash.[86] The CBA used by the researchers was available through the incineration process for sand replacement in making concrete. Silica, alumina, and iron are generally present in bottom ash with a high percentage.[89] The researchers have taken raw fly ash from MSWI plant equipped with a furnace to prepare sample of ceramic bricks.[96] Fly ash, MSWI fly ash, industrial quick lime, and FGD gypsum were used as raw materials by the researcher to prepare autoclaved wall blocks.[97]

Raw Material Preparation

Laterite soil, alluvial soil, and two months solid degraded MSW with 19% by weight of water was used for the preparation of fired bricks. The samples were dried out and ground to a particle size of about 1 mm for the preparation of bricks.[15] MSW incineration residues were obtained after the incineration process from Emerald Energy from the waste (EFW) plant.[78]

Production of Construction Materials

A mixture of decayed MSW was mixed in varying proportions example; 5% to 20% using laterite soil and alluvial soil for making the brick samples. To get the plastic condition of the binary mix the mixture was added with 20-25% water. The size of the prepared sample of bricks was 61 × 29 × 19 (all in mm) after hand. The brick samples were first air-dried for about 24 hours at room temperature and later, the samples were oven-dried (105±5°C) for next 24 hours to eliminate any presence of moisture in the samples. The samples were also fired at temperatures 850°C and 900°C with the help of an electrically operated muffle furnace.[65] The first step of the production procedure is the sieving and drying of received MSWI residues. An additive particle proportional to the MSWI residue, if necessary, for the clinkers. Turnover type ball mill blending was used to attain consistency of the blend. The blending of the mixture is shown best during the turning of the material at the time of rotation facilitating the particles to change position while rotating thereby achieving 3-D mixing. The turnover ball mill blending technique was used to produce eco-cement due to the good results.[98] Competent quality and developed strength of cement produced based on exhaustive mixing. Exhaustive mixing reduces the likelihood of containing lumps of material and makes the clinker products produced by this homogenous raw mix. The blend was further ground to a fine powder using ring-and-puck vibrator. After the thorough grinding, a water-solid ratio of 0.15 was mixed with the powder in the machine operating @35 rpm to produce spherical nodules. The nodules were produced with a diameter of 5mm to 20mm. Nodules smaller than 10mm and bigger than 10mm in diameter were segregated for better performance. Compressive strength tests were done for clinkered nodules after carbonation. The compressive strength was found to be insignificant for the clinker range of 5-20mm. After that nodules were placed in alumina vessels inside the furnace for clinkering. The process of clinkering was completed at varying temperatures keeping time of one hour as constant. The clinkers were allowed to cool and were retrieved from the furnace at room temperature. The clinkers were pulverized to produce eco-cement.[78]

Mechanical Properties of the Construction Material

Bricks made using laterite soil with 20% addiction of degraded MSW and fired at 850 °C indicated bulk density of 1.52 g/cm. Further, on increasing the firing temperature to 900 °C the bulk density was enhanced to 1.56 g/cm. Likewise, bricks moulded using alluvial soil with 20% addiction of degraded MSW showed a similar trend wherein the bulk density was enhanced from 1.49 g/cm to 1.51 g/cm when the firing temperature was elevated from 850 °C to 900 °C respectively. On the other hand, the water absorption in bricks was observed to be about 9% and 8% in case of bricks moulded using laterite soil and burned at 850 °C and 900 °C respectively. However, water absorption was found to be 11% and 10% in alluvial soil bricks for temperatures 850 °C and 900 °C respectively. Also, the apparent porosity increased due to the addition of degraded MSW. Lastly, the compressive strength of bricks moulded using laterite soil (9.96 MPa) was observed to superior to the bricks moulded using alluvial soil (3.63 MPa) at same firing temperature of 900 °C65. Maximum durability of hybrid bricks was achieved with the addition of 20% degraded MSW by its weight at 900 °C firing temperature. Wherein, the water absorption was observed to be increased in alluvial soil bricks compared to laterite soil bricks from 8% to 10% respectively. Also, the compressive strength was reduced by 70% in the case of laterite soil bricks and 77% in bricks made using alluvial soil. MSWI residues can be utilized to produce green eco-cement leading to a closed-loop and no residue incineration operation as an alternative to using a conventional cement kiln. Utilization of MSWI residues may contribute towards environmental sustainability, dipping the landfill of waste, dropping the carbon emission from MSW incineration and converging wastes into valuable products.[99]

Results and Discussion

As the world population grows and urbanizes, the demand for building materials and the waste generated by construction activities are increasing rapidly. This puts a strain on the environment and resources. The utilization of MSW in sustainable construction materials is an approach to address this issue by transforming waste into valuable resources. This involves using waste materials such as plastic, glass, paper, and construction and demolition waste as ingredients in the production of building materials. By incorporating waste into construction materials, the waste not only gets deterred from landfills and incinerators, but also cuts down the demand for raw materials thereby, conserving natural resources. Additionally, the use of waste-based building materials can lead to a reduction in the carbon footprint of the construction industry, as waste materials often have lower embodied energy compared to traditional building materials.

Various studies in this area have already been conducted and have been reviewed in the present review article to develop a scientific basis for the utilization of MSW in sustainable construction materials development. This article also helps to understand the properties and performance of waste-based materials and the potential for their use in various applications. This information would be helpful for the construction sector to design and develop standards and regulations for the use of waste-based materials. The significance of this review article lies in its potential to transform the construction sector into a more sustainable and resource-efficient sector. By leveraging the resources that are already available, we can contribute to a more circular economy and a more sustainable future.

Conclusions

Utilization of MSW in sustainable construction materials is the need of the hour. This review explores the available prospects through literature to produce construction materials from waste due to two broad reasons i.e., utilization of waste and conservation of resources, thereby conserving the environment. Strength and durability are important factors to consider in the construction industry, as they directly affect the performance and lifespan of a building. Studies have shown that the utilization of MSW in sustainable construction materials can provide materials with good durability and strength, making them suitable for use in construction. The studies assessed in this article highlighted the fact that the durability and strength of waste-based materials may vary depending on the type and source of the waste, as well as the processing and manufacturing methods used. Nevertheless, research has shown that the utilization of MSW in sustainable construction materials can provide materials with good durability and strength, suitable for use in construction, and contribute to the total sustainability of the built environment.

Acknowledgement
The review study is solely an independent work of the authors.

Funding Sources
The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest
Authors hereby declare no conflict of interest.

Data Availability Statement
The manuscript incorporates all datasets produced or examined throughout this research study.

Ethics Statement
The study does not involve any experiment on humans or animals.

Author Contribution
Md. Mumtaz Alam- Conceptualization, data curation,investigation and review editing.
Kafeel Ahmad-Supervision, formal analysis and plagiarism, Mehtab Alam-Supervision and formal analysis

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