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PROPERTIES AND CHARACTERICS OF REFUSED DERIVED FUEL.

Zohaib Hassan, Wiqar Ullah, Fawad Khan.

Graduate student, Civil Engineering Department, INU Peshawar, Pakistan, PH: 03345656151. Email:zohaibhassan3020@gmail.com.

Co-Supervisor, Civil Engineering Department, INU Peshawar, Pakistan, PH: 03128181476. Email:wiqarullah37@gmail.com.

Supervisor, Civil Engineering Department, INU Peshawar, Pakistan, PH: 03454836142. Email:fawadkhancivilian@gmail.com.

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Waste, Refused Derived Fuel, Management, Municipal Solid, Bottom Ash, Fly Ash, Pellets.

ABSTACT

This Review Paper is concerned with characterization of bottom ash (Refused Derived Fuel) from waste to energy power plant. Millions of tons of municipal solid waste (MSW) were produced every year, throughout the world. Waste management and utilization strategies were a major concern in many countries. Management and treatment of municipal solid waste have been gaining importance. Generally, Municipal solid waste was collected and burned in an incinerator and the by-products of the combustion process were collected, municipal solid waste (MSW) produces two main types of ashes, which can be grouped as bottom ash (BA) and fly ash (FA). Bottom ash typically accounts for 80% of the whole amount of by-products in the MSW plants. The municipal waste are separated into combustible and noncombustible waste and then from combustible waste pellets were formed from bottom ash and those pellets were burnt in an energy power plant for the production of energy to generate electricity and the residue in the bottom of an energy power plant was called refused derived fuel.

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1. INTRODUCTION

Municipal solid wastes (MSW) were produced in abundance every year. Waste management and utilization strategies were a major concern in many countries. Management and treatment of municipal solid waste have been gaining importance. Their waste ranges from relatively inert, e.g. glass bottles, excavated soil, building and demolition waste, to hazardous waste with high concentrations of heavy metals and toxic organic compounds [1]. Waste material can be utilized as fuel Incineration was a common technique for treating waste, as it can reduce waste mass by 70% and volume by up to 90%, as well as providing recovery of energy from waste to generate electricity. Generally, municipal solid waste (MSW) produces two main types of ashes, which can be grouped as bottom ash (BA) and fly ash (FA). Municipal solid waste was collected and burned in an incinerator and the by-products of the combustion process were collected. Bottom ash typically accounts for 80% of the whole amount of by-products in the MSW plants [2]. Then pellets were formed from bottom ashes and those pellets were burnt in an energy power plant for the production of energy to generate electricity and the residue in the bottom of an energy power plant was called refused derived fuel.

Refuse Derived Fuel (RDF) was produced from combustible components of municipal solid waste (MSW). The waste was shredded, dried and baled and then burned to produce electricity, thereby making good use of waste that otherwise might have ended up in a landfill.

Refuse-derived fuel (RDF) was a fuel produced by shredding and dehydrating municipal solid waste (MSW) with a waste converter technology [3]. RDF consists largely of combustible components of municipal waste such as plastic and biodegradable waste [4]. RDF processing facilities were normally located near a source of MSW and, while an optional combustion facility was normally close to the processing facility, it may also be located at a remote location. [5][6][7][8][9]

2. LITERATURE REVIEW

2.1. Road assets assessment:

During the past few years, several researchers have found new materials for structural concrete in civil engineering. This section is to review the characterization and use of ash from waste to energy power plant in concrete.

Mineral solids in form of fly ash and bottom ash are produced by burning municipal solid wastes in incinerators (MSWI). Fly ash is negligible and it is so chloride-rich that it cannot be used as mineral addition in cement-based mixtures for reinforced concrete structures [10].

On the other hand, bottom ash is about 25% with respect to MSWI and its chloride content is negligible, so that it could be potentially used as mineral addition for manufacturing concrete mixtures [11].

However, ground bottom ash (GBA) from MSWI does not perform as well as other mineral additions (silica fume or fly ash produced by coal burning) due to the presence of aluminum metal particles which react with the lime formed by the hydration of Portland cement and produce significant volume of hydrogen in form of gas bubbles which strongly increase the porosity of concrete and reduce its strength [11].

Due to this drawback, a new process was developed to completely separate the aluminum metal particles through a mechanical removal of metals and a special wet grinding of bottom ashes. At the end of the process GBA was used as aqueous slurry to replace Portland cement [12].

In the present work three slurries of GBA with different particle sizes were used to replace 20% of Portland cement in concrete mixtures. Concretes with Bottom ash (BA) from coal burning and silica fume (SF), from silicon manufacturing process, were also manufactured. Measurements of compressive strength and durability in terms water permeability; chloride diffusion and carbon dioxide penetration were carried out. The finest GBA (about 1.7 μm in size) performed as well as silica fume in terms of both mechanical properties and durability behavior, whereas the performance of the coarser GBA (about 3 and 5 μm) was higher than that of coal BA and lower than that of silica fume SF [13].

Municipals Solid Waste Incineration (MSWI) bottom ashes have an average chemical composition that is not dissimilar from that of coal fly ashes traditionally used as pozzolanic additions able to improve the durability of concrete[14]. In fact, MSWI bottom ashes are mainly composed of amorphous silica, alumina, iron oxide and calcium oxide [15]. This suggests that, once they are finely grounded, they can have pozzolanic or hydraulic behavior and their addition to a concrete mix can have a beneficial role in the development of the microstructure of the hydrated cement paste.

A great advantage in the sustainability of the concrete industry would be achieved if ground MSWI bottom ashes could actually be used as mineral additions. In fact, residues such as MSWI bottom ashes, which are available in great quantities throughout the world, could be converted into a resource able to produce quality concrete. Some researchers have actually shown the pozzolanic activity of ground MSWI bottom ashes showing their reactivity with lime or Portland cement clinker [16]. Nevertheless, no successful use of MSWI bottom ashes as mineral addition in concrete has been reported, because of the side effects of this addition. The main side effect is related to the evolution of hydrogen gas after mixing due to the presence of metallic aluminum [17]. In the alkaline environment produced by the hydration of Portland cement (pH around 13), corrosion of some metals (mainly aluminum) produces a great amount of gaseous hydrogen. After placing and compaction of concrete, this gas is entrapped in the fresh material, producing a network of bubbles that leads to significant reduction in the strength and increase in the permeability of the hardened concrete [18]. Our aim is to develop suitable treatments to allow the use of MSWI bottom ashes as mineral additions for the production of structural concrete without the evolution of hydrogen gas due to the presence of metallic aluminum particles.

MSW is a poor-quality fuel and its pre-processing is necessary to prepare fuel pellets to improve its consistency, storage and handling characteristics, combustion behavior and calorific value. Technological improvements are taking place in the realms of advanced source separation, resource recovery and production/utilization of recovered fuel in both existing and new plants for this purpose. There has been an increase in global interest in the preparation of RDF containing a blend of pre-processed MSW with coal suitable for combustion in pulverized coal and fluidized bed boilers. Palletization of municipal solid waste involves the processes of segregating, crushing, mixing high and low heat value organic waste material and solidifying it to produce fuel pellets or briquettes, also referred to as Refuse Derived Fuel (RDF) [19]. The process is essentially a method that condenses the waste or changes its physical form and enriches its organic content through removal of inorganic materials and moisture. The calorific value of RDF pellets can be around 4000 kcal/ kg depending upon the percentage of organic matter in the waste, additives and binder materials used in the process [20].

The calorific value of raw MSW is around 1000 kcal/kg while that of fuel pellets is 4000 kcal/kg. On an average, about 15–20 tons of fuel pellets can be produced after treatment of 100 tons of raw garbage. Since Palletization enriches the organic content of the waste through removal of inorganic materials and moisture, it can be very effective method for preparing an enriched fuel feed for other thermo chemical processes like pyrolysis/ gasification, apart from incineration. Pellets can be used for heating plant boilers and for the generation of electricity. They can also act as a good substitute for coal and wood for domestic and industrial purposes [21]. The important applications of RDF are found in the following spheres.

The conversion of solid waste into briquettes provides an alternative means for environmentally safe disposal of garbage which is currently disposed of in non-sanitary landfills. In addition, the Palletization technology provides yet another source of renewable energy, similar to that of biomass, wind, solar and geothermal energy. The emission characteristics of RDF are superior compared to that of coal with fewer emissions of pollutants like NOx, SOx, CO and CO2 [22]. RDF production line consists of several unit operations in series in order to separate unwanted components and condition the combustible matter to obtain the required characteristics. The main unit operations are screening, shredding, size reduction, classification, separation either metal, glass or wet organic materials, drying and densification. These unit operations can be arranged in different sequences depending on raw MSW composition and the required RDF quality. Various qualities of fuel pellets can be produced, depending on the needs of the user or market. A high quality of RDF would possess a higher value for the heating value, and lower values for moisture and ash contents. The quality of RDF is sufficient to warranting alone in a boiler designed originally for firing coal. At the present time most operating facilities in the United States recover the ferrous metal fraction present in MSW combustor ash(Bottom ash), which can comprise up to 15 percent of the total ash fraction[23]. Only a very small fraction (less than 5 percent) of the nonferrous fraction of the ash generated in the United States is recovered and utilized. Most of the ash is used as a landfill cover material. There is some commercial use of ash in road paving applications presently ongoing in Tennessee.

In some European nations (e.g., The Netherlands and Denmark), more than one-half of the bottom ash generated by municipal waste combustors is used in construction applications [24]. Lesser percentages are used in West Germany and France. In Europe the most common application is the use of ash as a granular road base material [25] In the United States and Japan, numerous studies in recent years have focused on the potential for using processed bottom ash and combined ash as an aggregate substitute in asphalt concrete, Portland cement concrete, and as an aggregate in stabilized base applications. Although neither federal nor most state regulations categorically restrict the use of MSW combustor ash (as long as the ash is determined to be nonhazardous in accordance with regulatory testing criteria), the presence of trace metals, such as lead and cadmium, in MSW combustor ash, and concern over leaching of these metals, as well as the presence of dioxins and furans in selected ash fractions (fly ash), has led many regulatory agencies to take a cautious approach in approving the use of MSW combustor ash as a substitute aggregate material.[26] The properties of the ash that may be made available for market will depend on the ash stream (e.g., combined, bottom or grate ash) that is proposed for use. In most cases combined ash contains excess unreacted lime that has been added as an acid gas treatment reagent and as a treatment additive to reduce the leach ability of trace metals that are present in the residue [27]. To reduce the fines content of combustor residues, pelletizing processes using Portland cement as a binding agent have been proposed and applied to improve the engineering and environmental characteristics of incinerator ash [28]. Verification, which is a high-temperature process designed to melt and subsequently cool the ash, has been proposed as a potential processing strategy. There are a number of commercial-sized ash systems currently in operation in Japan [30][30]. The high cost of verification, due primarily to the energy and facilities required to heat and melt the ash, tends to discourage the use of this technology in the United States. During the 1970's and 1980's a number of comprehensive investigations were undertaken to characterize the properties of municipal waste combustor ash [31]. Most of the data from these early investigations reflect the characteristics of ash from batch-fed or older continuous flow grate designs that are unlike the modern, high-efficiency energy recovery combustors in operation today. During the past few years there have been a number of comprehensive investigations that have characterized the properties of combined and bottom ash residues generated from these newer facilities [32].

3. CONCLUSION

Municipal solid waste (MSW) was the highly present material all over the world. Municipal solid waste (MSW) cause many diseases and also required much more land to accumulate municipal waste. So the waste material was a big problem for the advanced country, Pakistan was also one of these countries which have the problem of municipal waste material. The country and the land should be free from those municipal waste if there was a proper present for the municipal waste like if municipal solid waste was transported to Energy power plant system, where from municipal solid waste the combustible material was free from non-combustible material then from combustible material pellet were made then further from these pellet Energy in the form of electricity were produced, and also there was a Residue in the form of Bottom ash were obtained when the pellet was burned in energy power plant. Besides these advantages there was also much more land was free from these municipal solid waste and also the disease graph was also going down which were caused due to municipal solid waste. The residue of municipal solid waste (MSW) which name was bottom ash can be used in road pavement, in concrete, and also was additive, partial, and full replacement of cement if their chemical composition was under the requirement.

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