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BRIQUETTE MAKING EASES SOLID WASTE DISPOSAL

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DEFINITION

Solid waste includes all putrescible and non-putrescible discarded material including but not limited to garbage, rubbish, ash, street cleanings, dead animals, sewage plant sludge and industrial waste solids. Garbage is defined as putrescible animal and vegetable wastes resulting from the handling, preparing cooking and consuming food. It also includes wastes from markets and storage facilities that handle and sell other food products. Under rubbish are included the non-putrescible solid wastes (excluding ash) consisting of both combustible and non-combustible wastes. Combustible rubbish includes paper, rags, cartons, wood, furniture, rubber, plastics, yard trimmings, leaves and similar materials. Non-combustible rubbish includes glass, crockery, tin-cans, aluminum cans, dust, metal furniture and like material which do not burn at ordinary incinerator temperatures of 870°C - 980°C (1600°F to 1800°F). Ash is the solid residue from burning of wood, coal, coke or other combustible material.

THE PROBLEM

For centuries man has been polluting his environment with the by-products of his development and progress. Each generation has left for the next generation some improperly disposed of waste material. Each new generation has not only pushed aside its elders wastes but piled its own waste to be left to the succeeding generation.

Striking examples of this behaviour of man-kind throughout the centuries have been unveiled by archaeologists who have found whole cities buried under their own discards. In some cases three or even more layers helping to identify different periods have been found.

An ever-increasing amount of discarded materials has been a concomitant result. These discarded material are being produced now at such high rates that they are becoming a nuisance almost at the same time they are produced. Because of the neglect and the ever mounting quantities of wastes being produced and its indiscriminate disposal, many natural resources have been rendered useless or have become health hazards or at least have become scenic blights.

Solid waste and its management through final disposal have become a major problem. Open dumps are noteworthy examples of full environmental pollution at its best, by causing major impairment to surface and ground waters, contaminating the air, rendering the land useless and becoming shelter for disease carrying rodents and insects.

With the present trend of population migration towards the urban centres, large volumes of domestic refuse are being generated in small areas, making its management a major concern with many problems to be resolved. This problem is being worsened in every community with the increased waste production from commercial establishments, industries, restaurents and in many cases with agricultural waste from cattle, swine and poultry.

The problem is more acute in industrialised nations. In 1979, the per capita production of solid wastes was found to be 2.7 kgs (6 lbs) in USA, and it was 1.8 kgs (4 lbs) in Europe and Japan. In India, it was found to be 0.45 kgs (1 lb). Though the per capita production in India is much less than that in the developed nations, the total amount produced from a population of over 600 million people is considerable. It is projected that at the present rate of growth, in the year 2000, the total solid waste production will reach 300 million tonnes per year.

DISPOSAL METHODS

Too often, refuse disposal methods are open dumps festering scars that disfigure the landscape. Flies, rats, and other disease carrying pests find large quantities of food, a favoured breeding media, and suitable harborage in the piles of exposed refuse. The polluted drainage from open dumps is an additional insult to ground and surface water supplies in the area. Refuse fills are found to pollute the ground water by the following three basic mechanisms (ref.1)

1. Direct horizontal leaching of the refuse by ground water.

2. Vertical leaching by percolating water, and

3. The transfer of gases produced during refuse decomposition by diffusion and convection.

The characteristic foul odours produced by the decomposition of refuse, together with the smoke created by inefficient open burning, are often identifiable for miles.

The practise of feeding raw garbage to swine has both public health and economic implications.

Incineration disposes of garbage but it is costly. It is drawing increasing criticism because of the objections to air pollution. Single chamber incinerators and backyard trash burners especially contribute large amounts of air contaminants. The ash produced remains to be disposed of in other means. If incinerator ash is dumped on land, movement of water through these dumps will leach soluble salts and alkalies from the dump (ref.2).

Sanitary landfill is another method of disposal. It is consuming much of the accessible open area around many cities. Ground water in the immediate vicinity becomes grossly polluted by continuous or intermittent contact with deposited refuse. It was found that continuous leaching of a hectare-meter of sanitary landfill extracted a minimum of approximately 1.4 tonne of Sodium plus potassium, 0.9 tonne of calcium plus magnesium, 0.8 tonne of chloride, 0.2 tonne of sulphate, and 3.5 tonne of bicarbonate (ref.3). Composting is yet another method of disposal. In composting, the calorific value of the refuse is continually increasing but the nutrient composition is continually decreasing. Inability to dispose of large quantities of compost at a favourable price greatly affects the economy of the process in developed countries. Although compost contains some plant nutrients and trace elements, its principal value is in its use as humus for soil building or conditioning.

A second problem in composting relates to the hygienic aspect in plant operation and compost utilisation. Cleanliness and prompt handling of the wastes are essential to avoid the production of odours and propogation of such vermin as flies and rats.

Whatever the method, volume reduction of some kind has to be resorted to in order to conserve land areas for long term refuse disposal. Volume reduction may be achieved by various types of individual on-site disposal methods, such as burning, garbage grinding, and salvage or by the municipality employing incineration or composting.

IMPACT OF ENERGY CRISIS ON DISPOSAL

After the advent of the oil crisis resulting from the OPEC nations' oil embargo in 1973, the concept of solid waste disposal has changed. Refuse is no more treated as 'solid waste' but instead treated as 'wasted solid' thereby implying that it has high potential values. It is attributed to have the following unique desirable characteristics

1. It is available at no cost or perhaps at a negative cost.

2. The supply is increasing in amount.

3. The supply is concentrated at population centers where potential users are located.

4. Per calorie available from combustion, it contains less sulphur than coal or oil.

5. There are no vested interests to fight for legislation to stop complete depletion of this resource.

It was not usual to practice resource recovery or heat recovery from this material up until the energy crisis due to the following reasons:

1. The character of refuse makes material handling and treatment a major problem.

2. The capital and operating costs are so much higher, and efficiency so much lower than coal, that they over-shadow the negative raw material cost of refuse.

3. Incinerator methods utilised in past have not proved economical

Despite the fact that refuse is difficult to handle thanks to the energy crisis, there is now a renewed interest in incineration to recover energy. Several developed countries are now practicing resource recovery and heat recovery. Heat recovery is practiced by incinerating the combustible part of the refuse in suitably designed incinerators. Sophisticated mechanical process plants have been designed and are functioning to classify and segregate the non-combustible and combustible material. For developing countries like India, it is not necessary nor desirable nor feasible to copy the expensive sophisticated resource recovery systems of the developed countries. Nevertheless the concept is valid and can be adopted in an appropriate manner. Energy recovery can be practised at the household level itself. The householder segregates the metals, glass and other noncombustible material and prepares the refuse for its combustible portion. The combustible portion, being difficult to handle, is suitably subjected to a process wherein the handling problem is made easier. Once the handling problem is solved, it is used in domestic cooking ovens and can satisfy the fuel needs of the household. Handling problem is made easier if volume reduction is practised on the combustible part of the segragated refuse. This is achieved by making briquettes of handlable size. After proper drying, the briquettes can be used in the home burner. With this objective in mind, research work was initiated at the Center for Environmental Studies of Perarignar Anna University of Technology recently.

EXPERIMENT

Ten grab samples of 10 kgs each were collected from the Madras city refuse and were mixed together. Out of this 100 kg refuse, four equal divisions were made, each division containing 25 kgs. Two diagonal portions were discarded and the remaining two were mixed together making a heap of 50 kgs. This heap was again divided into 4 heaps of 12.5 kgs each. Again 2 diagonal heaps were discarded and the other two diagonal portions were mixed together making up a total of 25 kgs. This was again divided into 4 heaps, each of 6.25 kgs. Two diagonal heaps were discarded and the remaining two diagonal heaps were put together and thus a final sample of 12.5 kgs was obtained. The individual components such as paper, cloth etc. were segregated and their weights were determined and shown in Table 1 below.

<u>TABLE 1 Characteristics of raw refuse in Madras</u>

Item		Percent by weight
1.	Paper	14.0
2.	Cloths and fibers	7.3
3.	Iron	0.1
4.	Coal	0.5
5.	Leaves and grass	43.2
6.	Fine Earth	20.1
7.	Plastic	8.6
8.	Leather and Rubber	2.6
9.	Glass	0.5
10.	Wood and stick	3.1
	Total	100.0

All the combustible items were mixed together and a homogeneous mass obtained. This was then chopped into small pieces of size 1 cm or less. Sufficient quantity of water was added to adjust the water content to 30% by weight. A split type cast iron mould of size 6 cm x 3 cm x 3 cm as shown in fig.1 below was utilised. The chopped wet refuse was then pressed into the mould by hand and a plunger (shown in fig.1) was finally used to compact

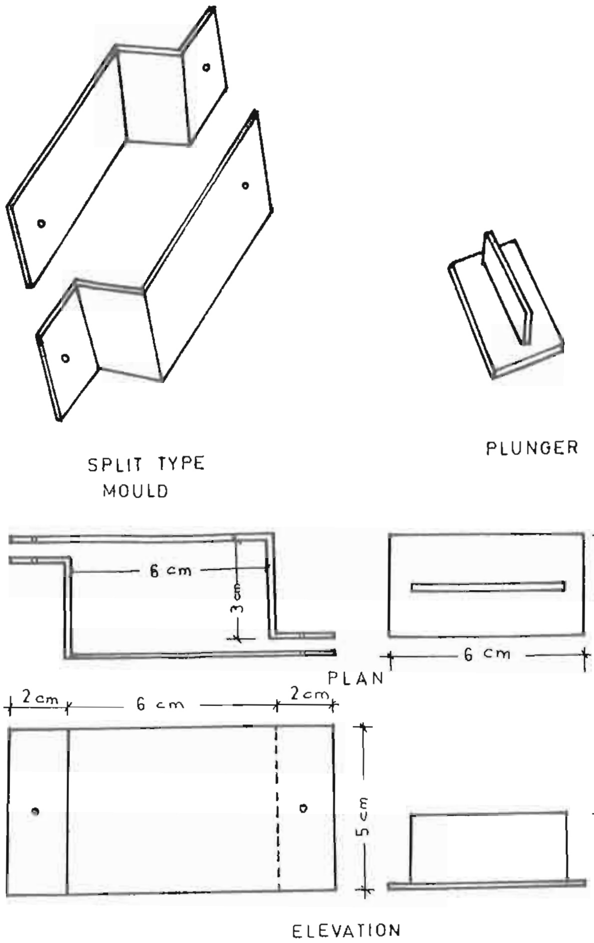

FIG.1 DETAILS OF MOULD

the refuse and to force the excess water out. Moderate pressure only was applied as too much compaction was not considered helpful for combustion. The refuse was kept in the mould for 24 hours before it was removed and dried in the natural sun for 4 days. At the end of this 4-day period, the briquette was burnt in a kitchen oven. As the sun drying took 4 days, it was investigated as to how to cut short the drying time. Drying in a laboratory oven at 104°C was tried. The calorific value of the briquettes was then determined using a bomb calorimeter. Totally 21 briquettes were tested for the calorific value along with 4 samples of coal (leco) for comparison purposes.

RESULTS

It took about 5 hours in a drying oven kept at 104°C to achieve the same amount of dryness as obtained in sun in 4 days. A well dried briquette spontaneously caught fire and needed no auxiliary fuel. A semidried briquette however required an auxiliary fuel in the form of kerosene. But all briquettes, when kept in a laboratory muffle furnace at 600°C, got burnt out completely leaving a residue of ash. The percentage of ash content varied from 35 to 45.

Table 2 below indicates the details of the briquette such as weight, calorific value and percentage ash for the 21 samples tested.

TABLE 2 Details of refuse briquette

Briquette weight gms	Calorific value cal/gm	Percentage ash
31.3	2459.8	43.16
32.8	1982.4	44.46
36.7	1929.8	41.26
37.9	1742.2	42.34
35.5	2072.4	44.49
33.9	1964.1	42.79
34.1	1603.3	47.77
39.5	1857.8	45.90
32.6	1748.8	46.28
36.2	1863.7	44.17
38.8	2288.3	49.07
32.4	1781.0	44.73
35.7	1992.5	46.27
34.6	1945.8	49.78
38.1	2517.2	48.84
37.4	1918.8	46.47
34.8	2040.3	51.32
33.9	1907.7	48.84
40.2	2436.0	43.32
36.9	1963.8	46.36
35.0	2127.5	41.00

Mean weight of briquette	39.82 grams
Standard deviation	2.35 grams
Mean calorific value	2006.85 Cals/gram
Standard deviation	236.51 Cals/gram
Mean ash content	45.72%
Standard deviation	2.85%
Mean calorific value of coal samples	5000 Cal/gram

CONCLUSION

From the limited experimental data available, it can be said that it is a viable proposition to make briquettes out of domestic refuse and to use them in cooking ovens at homes. This highly solves the handling problem of the refuse material and also eases its disposal problem with the attendant drawbacks and defects. Indirectly it helps to solve the energy problem to a great extent.

The briquette manufacturing can be resorted to in a mass scale also at a central location by the municipality. A central briquette manufacturing plant can be built and operated in the same manner as a disposal plant like a sanitary land fill or a compost plant. The briquettes may have a competitive market and so a self supporting project is envisaged. In the absence of specific cost data further comment on this aspect is withheld for the present.

REFERENCES

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