International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 11, Issue 11 (November 2015), PP.12-17

Briquetting of Organic Household Waste

Windi Zamrudy[1], Bambang Irawan[2], Eko Naryono[3]
[1,3] Teknik Kimia, [2] Teknik Mesin, Politeknik Negeri Malang

Abstract:- This study will be a package of technologies that can be implemented for various production capacities household waste. Long-term goal of this research improve national energy security in the solid fuel sector and specific targets are achieved at the end of this study: 1) produce an alternative solid fuels (of garbage) that can be used as a substitute fuel wood or other fuels, including for the purposes of household waste, 2) designing the prototype hidroulic press garbage, 3) measuring the calorific value of solid fuel quality produced, as well as pay attention to the quality of fuel briquettes produced. The method is performed on household garbage, garbage first settling for 1,3, 7, 12, 15 and 20 days in order to experience composting. Then pressed to remove fluid garbage.Briquetteanalyzed the water content then do briquetting and heating value. From time 1 day heating value in the range 1956.832 to 3257,24cal /g, while the water content at the biginning ranging 53-65%. For briquettes are produced on average 1.631% moisture content. The calorific value of the initial litter increased after briquetting.

Keywords:- household waste, compacted, pellet, heating value, moisture content.

I. INTRODUCTION

An Increase In The Volume Of Household Waste That Is Growing Every Day And Indicated To Contain Many Organic Ingredients As A Whole Although There Are Also Other Materials That Are Not Organic Materials Such As Heavy Metals Including Iron, Zinc, Tin, Mercury And So On.

Waste processing technology has done a lot to reduce the volume and the negative impact of garbage, including the combustion process is one effective method of waste treatment used. This system has the advantage, among others, can generate heat and require a short time compared with the degradation of organic waste in the landfill.

Organic waste is waste that can be degraded by microorganisms (quickly decaying), especially those from the rest of the food. Rotting rubbish (garbage) is waste that easily decomposes due to the activity of microorganisms. Thus management requires speed, both in the collection, disposal, and transportation. Decomposition of garbage can produce unpleasant odors , such as ammonia and other organic acids . In addition, also produced decomposition gases, such as methane and the like, which can endanger the safety if not handled well .

The energy requirement in rural household is mainly for cooking and sometimes heating in colder regions. So there is enormous demand for fuel wood. The one option could be the densification or briquetting to counter this problem. It has a great scope in rural Malang East Java Indonesia as it produces large amounts of bio waste material every year. This includes rice straw, wheat straw, coconut shells and fibers, rice husks, stalks of legumes and sawdust. Some of this biomass is just burnt in air; some like rice husk are mostly dumped into huge mountains of waste. Open-field burning has been used traditionally to dispose of crop residues and sanitize agricultural fields against pests and diseases [6]

The combustion process is able to reduce the volume of waste to 90% while composting, landfills and open dumping is only able to reduce the volume by 40%. However, the combustion process openly violate goverment regulationsof Indonesia No. 82, 2012.

This study is partly because in Malang, East Java, there is no waste treatment that uses an incinerator, 2) the water content in the trash sufficiently high so as to do the burning calorific value still low, 3) when the garbage in wet conditions when it is done burning, the flame produced is not stable. Through this research garbage can be processed and utilized as a fuel alternative energy also can be used as processing a variety of purposes including leachate treatment generated during the composting bins experience at some time.

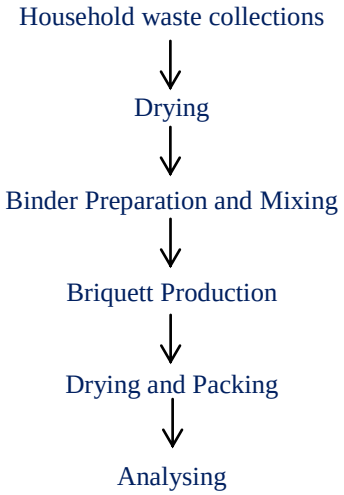
II. MATERIAL AND METHODS

This study was conducted in Tlogomas Malang City, whose population is quite densely populated settlements both natives and migrants because this city is a city that has a lot of interest in immigrants from students and local tourists from all over Indonesia. Malang population on 1 July 2015 amounted to 873 716 people, with an area of 145.28 km2, this city in East Java, which is located in the highlands, is 90 km from the city of Surabaya (East Java provincial capital). Because it is high, this city has the air cool and comfortable

place to visit. Malang is the second largest city in East Java after Surabaya, and is known by the town of students, or many are dubbed as the City of Flowers. From the development of the number of entrants in addition to increasing the income of the local population also affects the increasing number of household waste generated. Waste processing carried them done segregation between organic and inorganic waste. The processing of the constraints arising from, among others: 1) The high operating costs that are not comparable with the acceptance of the main obstacles in the implementation of this program, 2) treatment of wastewater (leachate) is not handled properly.

Gasification involves partial oxidation of the waste, again producing a syngas which then used to generate energy [3]. Initiative for current research came from industry, as several companies were interested in the treatment of municipal waste as substitute fuel for fossil energy carriers is very advantageous from economic as well as from ecological point of view. The basic ecological reasonfor stopping deposition of combustible wastes in dumps the fact that biological decomposition process forms methane gas which is harmful that carbon oxide [8]. The energetic value of non-recyclable household wastecan be reovered by gasification process. Before gasification this waste has to be crushed and compacted for handling but needs binder before it done. While municipal solid waste consists different types of materials; the heterogeneous mixture in composition and size [1]. Therefore it has to be processed the municipal waste before compacting/pelleting such as the disintegrating, drying, and homogenizing as shown in **figure** 1 [2].

Briquetting Process



Materials required

1. Organic Household waste (garbage)
2. Hidroulic Press
3. Weighing scale
4. Oven
5. Bomb Calorimeter
6. Binder (starch)

Garbage is collected from landfills, dried using air at 3 day intervals. Add each sample with the binding material and allow it to water content analysis. For preparation of binding material add starch to water in the ratio of 1: 20 and allow it to disperse without any clumps. Then heat the solution for 10 minutes and do not allow it to boil. After boiling pour the liquid (as much as 10% of the sample weight) onto the shrededhousehold waste and mix to ensure the every parts of shreded household waste is sticked with the binder. Briquettes produced by compressing a sample that has been mixed with the Binder (adhesive) in a cylindrical mold, the results were dried using ambient air for two days. Briquettes tested the ability of the flame with the aid of compressed air coming from the low-pressure air pumpand Calorific value of each briquette tested in laboratory using the bomb calorimeter.

Figure 1.Schematic illustration of household waste treatment before gasification.

The household waste that used for the current research was brought directly from landfill which has high moisture content and of course contaminated and heterogeneous in composition. Therefore, the household waste had to be dried to reduce moisture content in the material and shred for size reduction [7]. The household waste was weighed, added a few of binder (starch) and compacted with two kinds of hydraulic press as shown in figure 1.

One of important parameters of briquetting is density, where the higher the density, the higher is the energy/volume ratio. Hence, high density products are desirable in terms of transportation, storage, and handling. The densities of biowaste briquette depend on the density of the original biowaste, the briquetting pressure and, to a certain extent, on the briquetting temperature, and time [7], [2].

III. RESULTS AND DISCUSSION

During the briquetting material with binder less than 5 persenaffects the product cannot be compacted well, as well as diverse waste composition can affect the quality of the resulting briquettes. From two kinds of products above, the briquette without hole has better results which burned/gassified easily with addition of air supplied by low pressure compressor than briquette with hole one.

According the results above many factors influence heating value of gasification namely household waste composition, density, binder used, compactness. From this research shown that calorific value of the briquette produced much lower than briquette from biomass charcoal briquetting which has calorific value from Therefore to produce better briquette quality some additives must be added such as wood sawdust, paper, plant leaf, coal. The density of household waste range from 1,24 to 2,08 may due to inhomogeneous sample mixed that may affect the production of briquettes.

All equipments for briquetting carried out in manually, after the briquette formed then analysed the water content, heating value. While measuring the density whichcarried out at the beginning of household waste before briquetting for consideration in assessing the diversity of shapes and sizes of raw material influence on the resulting briquettes.

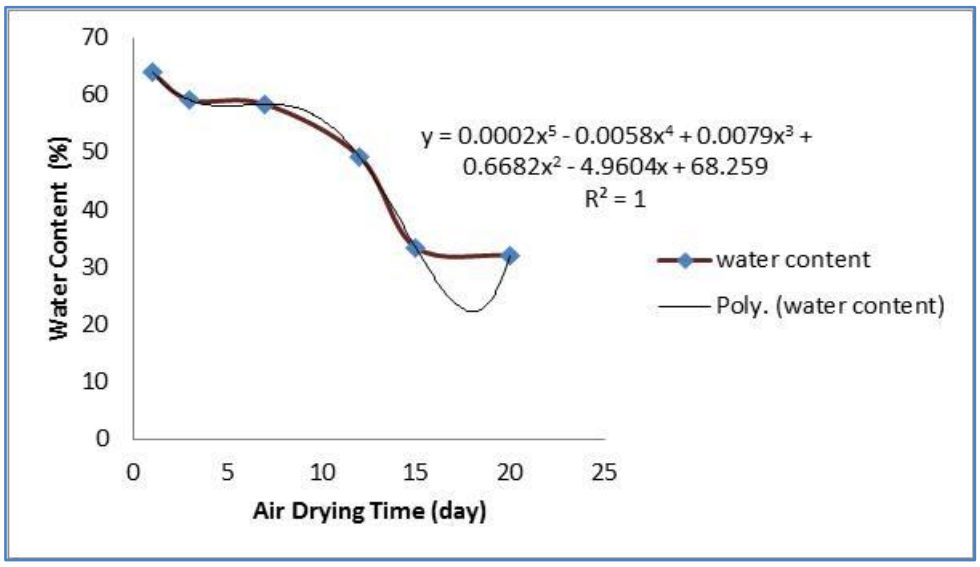


Figure 3. Water content of original household waste after several days

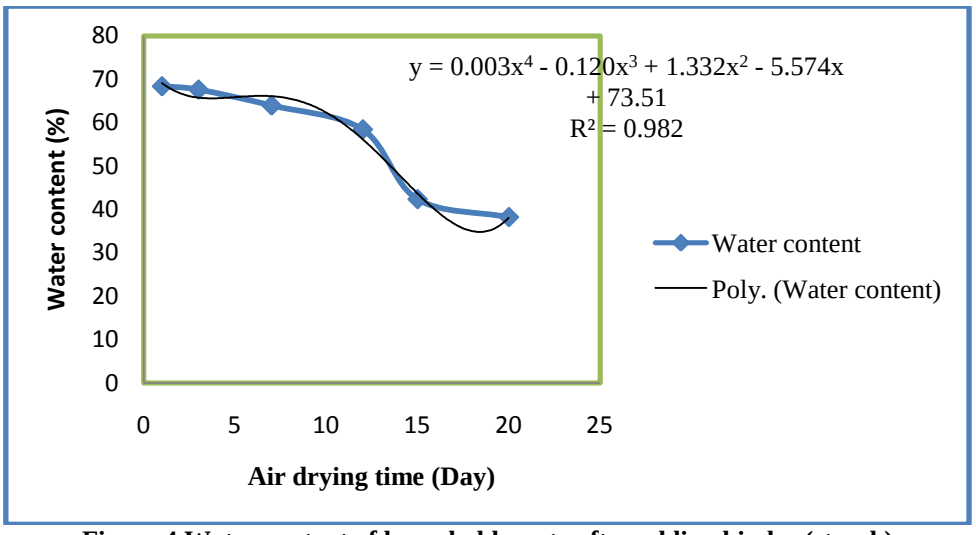


Figure 4.Water content of household waste after adding binder (starch)

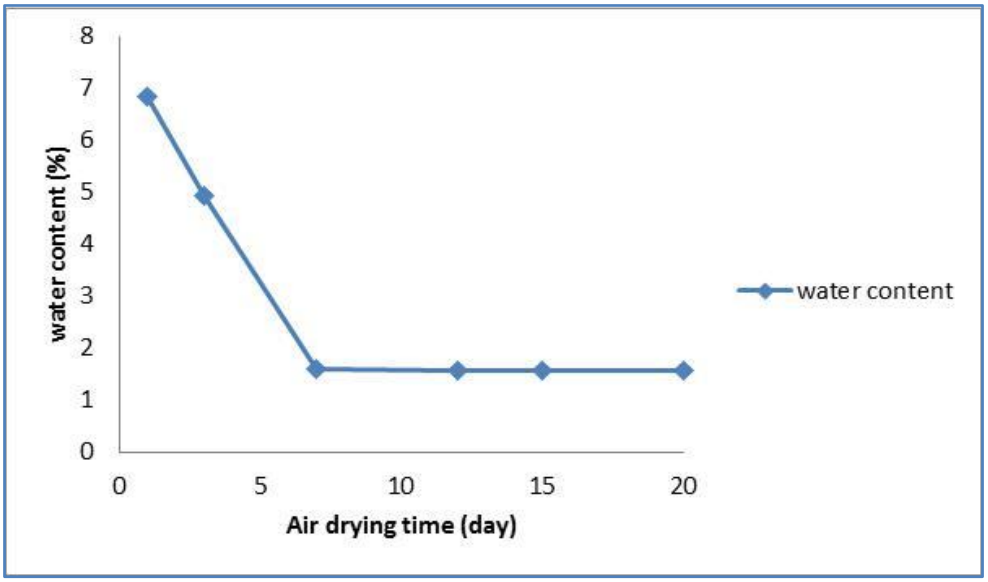


Figure 5.Water content of household waste after briquetting

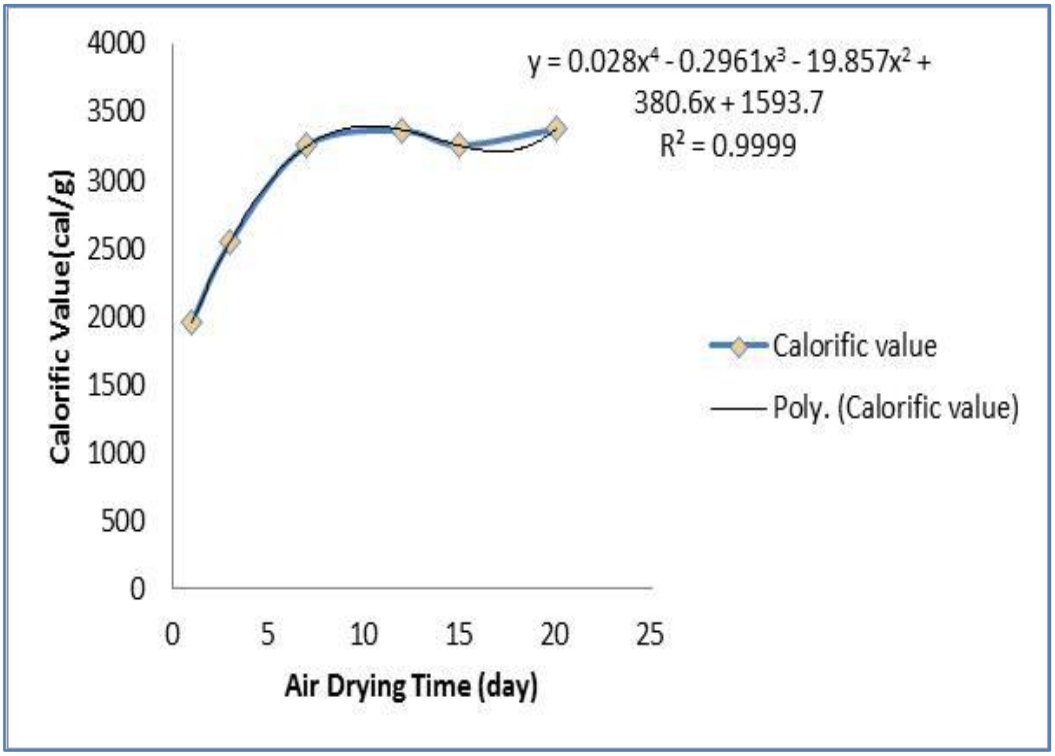


Figure 6. Caloric value of household waste after briquetting

Briquetting is the process of converting low bulk density biomass into high density and energy concentrated fuel briquettes [4] According to **fig. 6** above, briquette has specific characteristics where caloric value ranging from 1955,98 to 3257,24 cal/g, the high moisture content makes the heating value decreased.

However, during compaction of briquettes, wet household waste need to be kept on pressing at least for 40 seconds and compaction pressure should not be less than 1 MPa for the purpose to yield good quality briquette. During drying of briquettes, wet briquettes should be placed at windy places so that air circulates around its surfaces. The studies also indicate that briquette should be dried up to 8% moisture content otherwise it will cause severe smoke formation during burning[6].

Independently the type of material to be compacted, its moisture content, fraction size, pressing temperature, and compacting pressure are the most important parameters to manufacture briquettes with acceptable quality. The pressing temperature and compacting pressures depend on the type of briquetting machine used. Fraction size has great influence on the briquetting process. The coarser the fraction is, the higher compacting power is needed for briquetting. Briquette has lower homogeneity and stability. By increasing the fraction size, the binding forces inside the material decrease which effects on faster decay by burning (briquette burns faster and that is not an advantage)[7].

Analysis was not conducted on this household waste contamination by various metals such as Ward [5] said that "the problem of environmental pollution due to toxic metals has begun to cause concern nowin most major metropolitan cities. The toxic heavy metals entering the ecosystem may lead to geoaccumulation, bioaccumulation and biomagnification. Heavy metals like Fe, Cu, Zn, Ni and other trace elements are important for proper functioning of biological systems and their deficiency or excess could lead to a number of disorders"[5].

The compactness of briquette makes handling easier, not too much space used, high density, however for a certain material makes the briquette not easily combustable even air supplied injected.

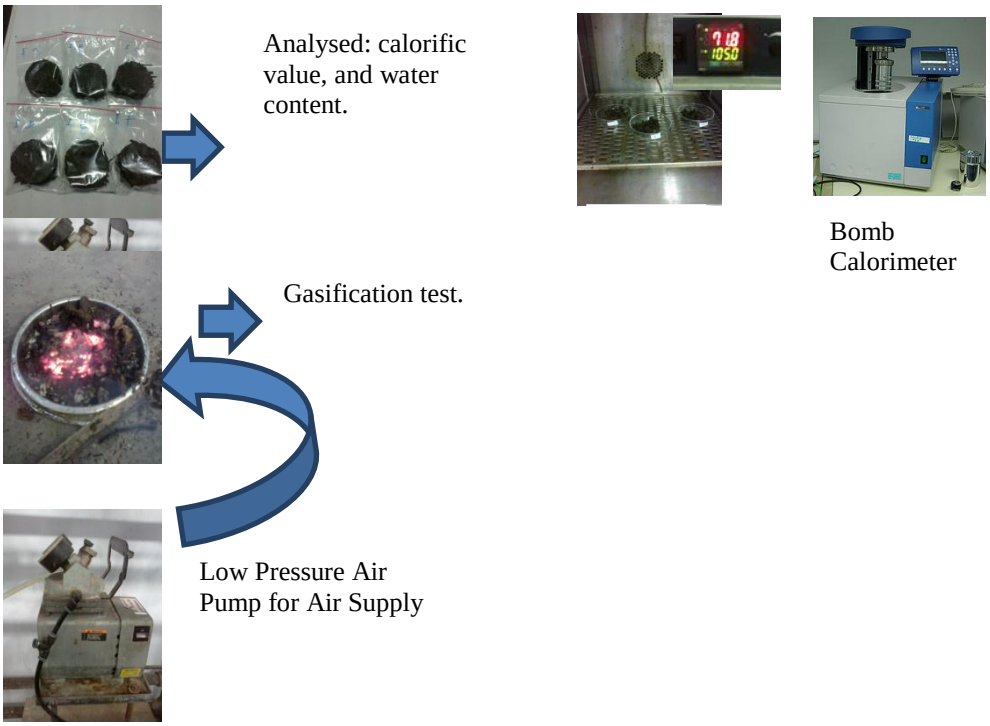


Figure 7.Schematic illustration of household waste gasification testafter treatment.

IV. CONCLUSIONS

To make better quality of briquettes some considerations must be taken, wet briquettes should be placed at windy places so that air circulates around its surfaces and on this situation less energy required for drying, make sure materials composition of household waste give higher calorific value otherwise it should be mixed with other materials which have higher caloriicc value such as paper, sawdust,etc. Household waste should be shreded/chopped before mixing with binding material to have better briquette results.

ACKNOWLEDGMENT

The paper is funded by the Directorate of Higher Education in the Ministry of Education, Research and Technology. The authors are grateful to the editorial board of International Journal of Engineering Research and Development (IJERD) for their valuable suggestions; all errors remain to the authors.

REFERENCES

[1]. Al-Salem,S.M., Lettieri,P.Baeyens,J.:Recycling and Recovery Routes of Plastic Solid Waste (PSW): A review.Waste Management,29,2009,2625-2643
[2]. Kers, J., Križan, P.,Letko,M.:Mechanical Recycling of Compounded Plastic Waste for Material Valorization by Briquetting; In:Baltic polymer symposium. 2009.
[3]. Williams,P.T.,"WasteTreatment and Disposal", Chichester, UK:John Wiley & Son, 2005, 375 pp.
[4]. Sugumaran, P., Seshadri, S.," Biomass Charcoal Broquetting" Technology For Alternative Energy Based Income Generation In Rural Area, 2010.
[5]. Ward, N.I. 'Environmental Analytical Chemistry', in Fifield, F.W. and Haines, P.J. (Eds.): *Trace Elements*, pp.320–328, Blackie Academic and Professional, UK.1995.
[6]. Bikash,B., Bhowmik,R., Saikia,M..: Challenges of Wet Briquetting from Locally Available Biomass with Special Reference to Assam"*International Journal of Computational Engineering Research* (IJCER),Vol,03.Issue,7.2013
[7]. Križan,P.,Matúš, M.,Šooš, L.Kers, J., P. Peetsalu, Ü. Kask and A. Menind, "Briquetting of municipal solid waste by different technologies inorder to evaluate its quality and properties"*Agronomy Research* Biosystem Engineering Special Issue 1, 115-123, 2011
[8]. Halmann, M. M, Steinberg, M., Greenhouse Gas Carbon Dioxide Mitigation: Science andTechnology, 1998, CRC Press, 568 pp.