Proceedings of the
International Conference on Mechanical Engineering and Renewable Energy 2017
(ICMERE2017) 18 – 20 December, 2017, Chittagong, Bangladesh

ICMERE2017-PI-160

MANAGEMENT OF MEDICAL WASTE AS A KEY FOR INNOCUOUS CITY DEVELOPMENT: A CASE STUDY IN JESSORE CITY, BANGLADESH

Uday Som[1] and Md. Shameem Hossain[2]

[1]Department of Chemical Engineering, Jessore University of Science & Technology, Jessore- 7408, Bangladesh.
[2]Department of Energy Science and Engineering, Khulna University of Engineering & Technology, Khulna, Bangladesh.
somuday1105@gmail.com, shameemkuet@gmail.com*

Abstract*-Management of medical waste is a key for innocuous city development and that's first principle is don't any harm. The misconduct of it may be a momentous risk factor for infections transmission on our environment. The study was conducted on one public hospital, fourteen private hospitals and clinic and thirteen diagnostic centers of Jessore city of Bangladesh. The study focused on the generation rate, standing management system and problems of medical waste management. A limited number of health care establishments (HCEs) are following the medical waste management (MWM) approach through their self-management. The outcomes of this study interpretation that approximately 3 ton of medical waste is produced per day which is around 6.89% of total waste generation in this city. Over on an average 0.98kg/day/bed medical waste covering 15.82% plastic, 10.89% infectious, 3.46% sharp, 5.52% pharmaceutical, 3.87% pathological and 60.94% domestic waste were generated in this city.*

Keywords: Health care establishments (HCEs), Medical waste, Health effect, Medical Waste Management (MWM)

1. INTRODUCTION

Bangladesh is a developing country with a swiftly developing urban population, widespread health problems, little educational status and great environmental pollution [1]. Medical waste is asubject of mounting concern since difficult of medical waste is appeared as one of the most significant phenomena over the past three decades [2]. One estimation shows that several 5.2 million people (comprising 4 million children) die each year in the sphere from waste-related diseases [3].So as to safeguard a sound environment for our health, MWM is a compulsory phenomenon. Medical wastes usually account for a very minor fraction, about one percent of the entire solid wastes produced in Bangladesh [4] that can be extremely toxic as well as infective and unrestrained damping of this waste threatens environmental and human health. Healthcare waste management (HCWM) is stagnant a foremost challenge for health services in developing countries where the health care staff and nearby population is unprotected to risks because of deprived handling of waste [5]. Medical waste is accomplished of causing sicknesses and illness to publics, either through direct or indirectly by polluting ground water, surface water, soil and air [6]. Up till now, there was no well-organized scheme for appropriate medical waste management (MWM) in Bangladesh to protect environmental health dangers. A decent number of international and national studies described that there have been very partial good practices of disposal or dumping of health care waste in Bangladesh. It has been informed that maximum of the hospitals, excluding a few private hospitals, dispose health care wastes beside the road sides as the commercial and solid wastes are disposed [7].Improper dumping of medical waste may comprise damage to humans by harsh instruments, diseases transferred to humans by infective agents, and pollution of the environment by hazardous and toxic chemicals [8]. The mishandling of the biomedical waste poses serious risk to publics and the environment. It is significant to dispose of such waste correctly to avoid its hazardous effects [9]. The effects of mishandled hospital waste are said to be massive and extreme [10]. Acharya and Singh (2000) recognized the medical waste management method to comprise handling, segregation, disinfection, storage, collection, transportation and final disposal. They propose that these are vigorous steps for harmless and scientific managing of medical waste in any medical institution. Poor management, deficiency of handling information and unempirical disposal of numerous health-care wastes produce serious direct and indirect community health intimidations to health-care nurses, technicians, personnel, waste workers, patients, hospital visitors, surrounding communities and the environment as well [11]. In the case of Bangladesh utmost of the waste handlers are from lower socio-economic situation with big family size, lower level of learning and knowledge. They typically handle the medical wastes

without using necessary equipment [12]. Therefore; MWM is the key portrait for innocuous town development for a developing country like Bangladesh. The key goal of this study is to emphasis on the managing scenarios and conceivable threats of hospital waste in Jessore town. Also this study is endeavored to focus on the demand of MWM for protecting and safeguarding health of environment.

1.1 Paper Heading

There is no on its own definition of ‘‘medical waste’’. The terms medical wastes, hospital wastes and infectious wastes have continually been castoff interchangeably [13]. Medical wastes are infective and hazardous. Medical waste can be reasons serious threats to environmental health and needs precise management and handling previously to its concluding disposal [14]. Medical wastes are arising from analysis monitoring and preventive, relaxing or therapeutic activities in the pulverized of the veterinary and human medicine [15]. The new progresses medical services are exactly made for the anticipation and safety of the public health. In numerous processes for diseases treatment the exhausting of sophisticated instruments is rising. Such advances and development in scientific knowledge has initiated in per capita per patient generation of wastes in healthcare entities [16]. The classification of medical waste is as shown in table 1.

Table 1: Classification of medical waste

Laboratory waste	Clinical waste	Non-clinical waste	Kitchen waste
Chemicals used in the pathological lab	Blood collection tubes	Plastics that have no contact with body fluid	Potential source of vermin and pest
Microbial cultures and clinical specimens	Gauze and bandages	Wrapping paper	Wash and waste water
Needle	Vials	Office paper	Food waste
Culture dish	Body fluids		
Syringes	Glassware		
Radioactive waste	Drainage bags		
Slide	Culture dishes		

2. METHODOLOGY

2.1 Study Area

Jessore, is the present study area, the main district of undivided Bengal which is an increasing center of southwestern Bangladesh. It is a major industrialized and commercial center stands on the bank of the river Bhairob. Jessore district is presently covers region of 2578.20 sq. km in which Jessore town covers a region of 25.72 sq. km. and the residents of the district was around 2,440,693 in 2012 estimation. In fact Jessore town has a population (1,178,273) nearly half of that of the entire district (Bangladesh Bureau of statistics, 2012). The district lies between 22º 48' and 23º 22' north latitudes and between 88º 51' and 89º 34' east longitudes. Jessore town appearances an excessive environmental difficult due to inappropriate management of MSW [17]. Entirely the waste of Jessore town is dumped in two particular areas of Hamidpur and Jhumjhumpur. This study has been planned to selection of healthcare institutes, collection of primary and secondary data, field observation data analysis and lastly proposals for the development of present situation of MWM as shown in figure 1.

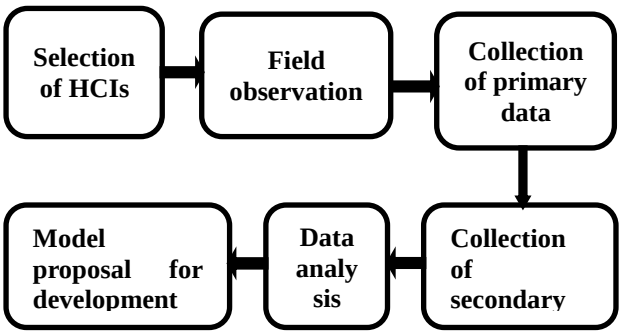

Fig.1: Planning of study

2.2 Samples and Procedure

No statistically rigorous sampling process could be followed for this study. That Health Care Establishment (HCE) who was willing to afford us info was selected for this study. It was not informal to collect appropriate medical waste data from HCE ever since utmost of the HCE did not keep an eye on the prevailing regulation and rules to run them appropriately. For this cause some of the HCE the ruling classes were not attentive to give consent in gathering data from their own establishments. A total of 22 out of existing 69 HCE in the study area gave consent to gather data. Primary data were collected through Interview, actual measurement, direct field observation and questionnaire survey. A face-to-face direct key informant interview was completed among the diverse respondent group. Previously entering a HCE, a numeral of official meetings being organized with the apprehensive authority of each HCE to elucidate the effectiveness of the study and pursue their cooperation. Afterward receiving consent, investigation was started. Sampled establishment were nominated using random sampling technique intended for data collection. Equally primary and secondary data have been collected for this study. Name of the selected health care establishments are as shown in table 2.

Table 2: Name of the selected HCEs

Name of the selected health care establishment
Queens Hospital (pvt.) Ltd.
Lab Aid Hospital and Diagnostic Centre
250 beded General hospital, Jessore
Ekota Hospital and Diagnostic Complex (Pvt) Ltd.
Doratana Hospital
Unique Hospital and Diagnostic Centre

Modern Hospital and Diagnostic Centre
Ad-din Shisu Hospital
Ad-dinShakhina medical college Hospital (Ad-dinmadical)
Rotary Health care center
Central Hospital and Diagnostic complex
Ibn-Sina Hospital and Diagnostic Centre
Jonokollan Hospital
Squaire Diagnostic Centre
Lab scan diagnostic center
Sunrise Diagnostic Centre
Popular Diagnostic Centre
Prime Diagnostic Centre
Comtech Diagnostic Centre
Nova medical Center
Jhorna Clinic
JonotaHospital and diagnostic center

A practical questionnaire survey was passed out for the gathering of primary data about the remaining management scheme of medical waste in the study area finding factors which frontier suitable disposal of medical waste in Jessore City.

3. RESULT AND DISCUSSON

3.1 Waste Generation

Medical waste produced from the regular events of the nurses, cleaners, sweepers, patients, doctors and administrators etc. that are rejected as useless. Medical wastes are formed from the cabin, Operation theatre, outpatient department, ward, pathology etc. Size of the waste mainly rest on upon the outdoor patients and beds that signify the sources of waste generation. Distribution of waste generation is as shown in table 3.

Table 3: Distribution of waste generation

Waste type	Maximum value (kg/day/bed)	Minimum value (kg/day/bed)	Mean (kg/day/bed)
Total waste	1.390	0.570	0.980
Plastic waste	0.141	0.047	0.188
Sharp waste	0.013	0.004	0.017
Infectious waste	0.075	0.025	0.100
Pharmaceutical waste	0.039	0.005	0.044
Pathological waste	0.026	0.008	0.034
Domestic waste	0.448	0.149	0.597

Furthermore, from this study the quantity of clinical waste (except domestic waste) was established to be 0.79 ton/day. In mixture, around 54 ton solid waste is generated in this town that comprises 3 ton of medical waste (both domestic waste and clinical) that is around 5.96% of total solid waste production. Additionally, the rate of production of clinical waste (except domestic waste) was about 1.93% of total solid waste in this town. Types of medical waste (%) are as shown in figure 2.

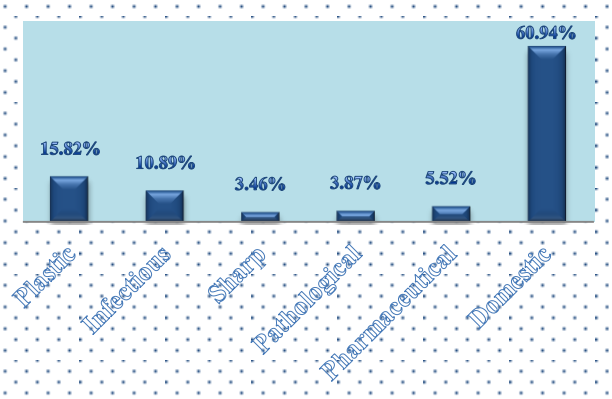

Fig.2: Types of medical waste (%)

3.2 Handling of Medical Waste

The prevailing Environment Conservation Rules, 1997 had no detailed laws directly related to MWM. Usually, the rule comprises proposal for use of diverse color coded container for isolation of medical waste at source and symbol to be castoff on the packing of medical waste and transference. The rule identifies the standard for Pyrolysis, deep burial, Incineration, and radioactive waste disposal and treatment. Pyrolysis is the appropriate method of hazardous waste dumping and regaining of energy from it [18] In this study investigated that only around 28% HCEs use CCCs for the separation of numerous kinds of wastes while about 32.% hospitals do not use it properly regardless of having CCCs as suggested by ECR ' 97 and WHO. However, approximately 40% HCEs do not have any color CCCs whatever. The present situation of use color coded container (%) is as shown in figure 3.

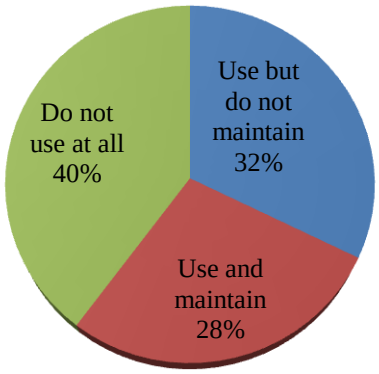

Fig.3: Uses of Color Coded container (%)

Furthermore, very nearly all the HCEs do not follow any inscribed guidelines and naturally the cleaners do not have any alertness regarding the significances of medical waste [19]. The systematic use of proactive wear as suggested by PRISM Bangladesh and ECR'97 was found to be only 19.69% while for exceptional cases it was 44.89% and in 35.42% cases they do not use it whatever. The present situation of use proactive wear (%) is as shown in figure 4.

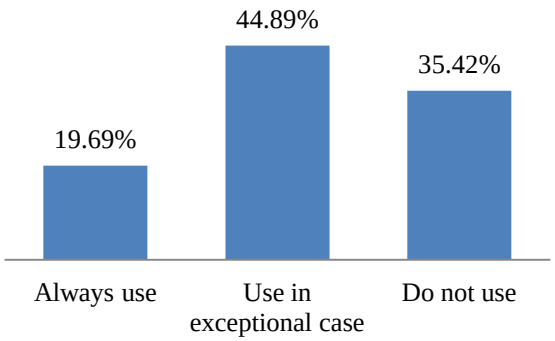

Fig.4: Uses of proactive wear (%)

3.3 Waste Separation Position

It was initiate that about 24.70% of the sample HCEs separated sharp equipment in the wards, 26.97% HCEs were complete it at the time of generation and about 48.33% hospitals did not segregated it at all. Moreover, around 14.46% sample HCEs separated infectious waste at the time of generation, while 25.43% for time of collection and 52.29% hospital did not completed separation operation at all. The separation situations of various types of waste are as shown in table 4.

Table 4: Waste separation position

Position of waste segregation	Sharp	Infectious	Plastic
At the time of generation	26.97%	14.46%	29%
In wards	24.70%	7.82%	31.79%
Collection time		25.43%	
Do not segregate	48.33%	52.29%	39.21%

3.4 Storage, Collection and Transportation

In all studied HCEs, utmost of the types of wastes were kept in CCC or the provisional storage or dustbin outer side of the hospital premises deprived of any disinfection. It was also initiated that some medical staffs earn some money through selling secondhand syringes and additional medical wastes. Over some wastes are dumped into the nearest river of Daratana which contaminates the river water constantly. Now and then waste were found to be discarded in the hospital premises for an extended period of time deprived of any management or any kind of disinfection process. The present scenario of medical waste damping is as shown in figure 5.

Fig.5: Present scenario of waste disposal in jessore [20]

3.5 Present Waste management problems Identified by the Respondent

There were numerous kinds of difficulties identified by the respondents for the Jessore city to handling the appropriate waste management. Outcomes of the respondent view about difficulties of waste handling identified by the respondents are as shown in in table 5.

Table 5: problems of handling MW identified by the respondents

Problems for proper waste management system	Percentage
Absences of adequate dustbin	12.52
Lack of awareness	11.39
Lack of knowledge of the manpower	10.64
Lack of trained and sufficient manpower	09.28
Lack of proper segregation	09.52
Mishandling of medical waste	8.99
Lack of appropriate guideline	6.62
Due to offensive odor	5.68
Reuse or resell of waste materials	5.24
No enforcement of law	4.98
Lack of government budget in this sector	4.09
Lack of monitoring of the HCEs	3.99
Possibility of Disease infection	2.93
No chain of command	2.15
Negligence of the authority	1.00
Insufficient technology for waste treatment and disposal	1.00

Source: Field survey, 2017

It is clear that there was a deficiency of adequate number of basket for the collection and storage of waste. Maximum of the respondents talk about that the lack of adequate bin lack of awareness, lack of knowledge of the manpower for handling, lack of sufficient and trained manpower etc.

3.6 Health Effect

Waste managers are distressed by diverse types of the health effect because of pathogenic organisms of medical waste. One assessment shows that a number of such that 5.2 million people (comprising 4 million children) die each year in the sphere from waste-related diseases [21]. By survey it was detected those respondents were suffering from vomiting and headache in higher percentage 35% and 32% respectively. Some of the respondents met heart pain (18%) for the period of the waste handling particularly the anatomical waste during the first time of the services. The present scenarios of diseases, people who are related to waste handling of medical waste purpose are as shown in figure 6.

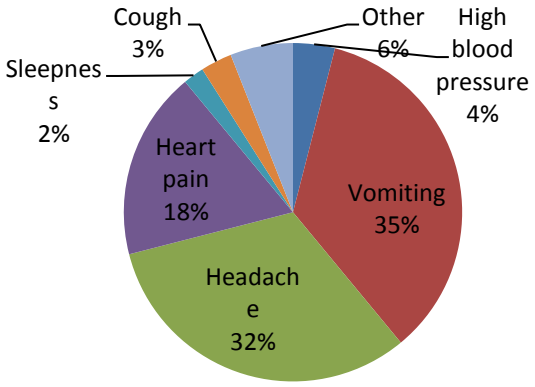

Fig.6: Health effect associated with MW handling

4. Suggested Model for MWM

Throughout the survey the respondents opined for the development of the present medical waste management system. They suggested for the HCEs authority for providing adequate amount of dustbin and regular monitoring for the wellbeing of the management of the medical waste. Respondents moreover provided their opinion for the government actions which should be taken for the development of medical waste management system and safe the environment. They also recommended for the government sector for the systematic valuation of the monitoring by the specialist and arrangement of the program for increasing awareness. Respondent recommended various tricks for safe management. Proposal for upgrading of existing waste management system in the Jessore city are as shown in table 6.

Table 6: Proposal for upgrading of existing waste management system in the Jessore city

Proposal for upgrading MWM	
1	Afford sufficient quantity of waste bin
2	Adequate amount of colored coded waste bin
3	Suitable technical instrument for waste handling and disposal
4	Establishment of an environmentally sound medical waste treatment and disposal scheme
5	Encourage people for recovery of resource from medical waste
6	Confirming worker safety through training, education and appropriate personal protective equipment.
7	Afford suitable place for waste disposal
8	Construct law and enforce it
9	Provide satisfactory budget for waste management sector
10	Disinfection of the wastes before disposal.
11	Establishment of a separate unit for sharp
12	Provide suitable guideline to the worker
13	Conduct with diverse NGOs for the development of the existing waste management
14	Systematic monitoring
15	Construct waste safety department

Source: Field survey, 2017

A model can be suggested for safe medical waste management for jessore town as shown in figure 7

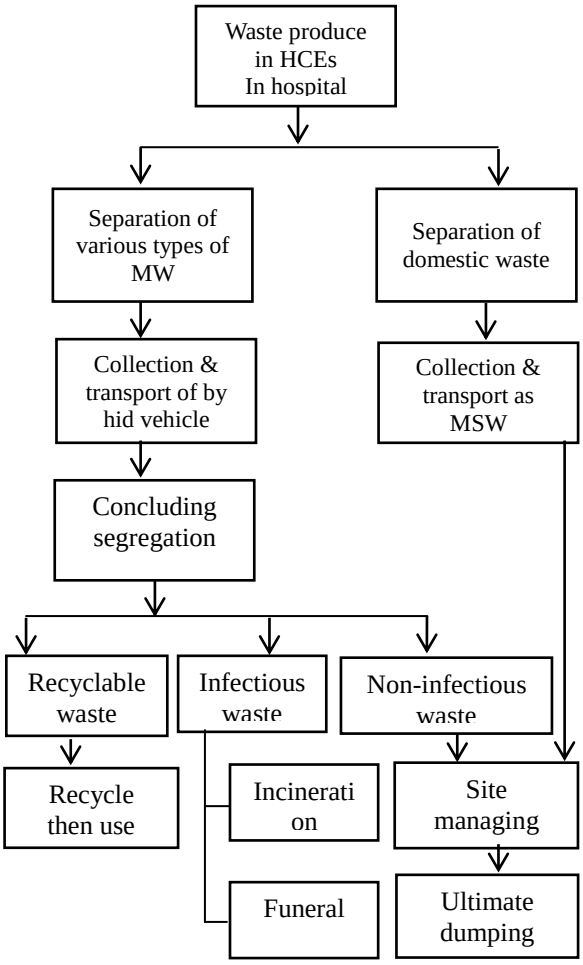

Fig.7: Model for MWM

5. CONCLUSION

It is incredible to replicate a safe town without proper management of waste especially medical waste. This

study has been concentrated on the management situations and possible threats of medical waste in Jessore city of Bangladesh. The findings of this study expose that around 3 ton of medical waste is produced each day. Separations of numerous types of waste are not set up to be done satisfactorily in most of the health care establishments (HCEs). Additionally, there was no indication of accomplishment of disinfection operation for maximum of medical waste and the provision of color coded container (CCC) was not retained appropriately. MWM must be measured as a major issue in the modern age. This study has been appraised the key structures of the current situation of MWM in Jessore city and the impending strategy for proceeding this state.

6. REFERENCES

[1] Kabir, Z. N.; Tishelman, C.; Torres A. H.; Chowdhury, A. M. R.; Winblad, B. and Hojer, B.2003. Gender and rural-urban differences in reported health status by older people in Bangladesh. Arch. Gerontol and Geriatr., 37:77-91.

[2] Rahman, M. N.; Islam, M. T. and Baten, M. A. 2007. Waste disposal and management system in rural and municipal areas of Dinajpur district. Bangladesh J. Environ. Sci., 13(1):25-38.

[3] Halder, P.K., Paul, N., Hoque, M.E., Hoque, A.M., Parvez, M.S., Rahman, M.H. and Ali, M., 2014. Municipal solid waste and its management in Rajshahi City, Bangladesh: a source of energy. International Journal of Renewable Energy Research (IJRER), 4(1), pp.168-175.

[4] World Bank, 2002. Health Facility Waste Management Study in Bangladesh. Dhaka: World Bank.

[5] Jang, Y. C.; Lee, C.; Yoon, O. S. and Kim, H. 2006. Medical Waste Management in Korea.*J. Environ. Manage.*,80:107-115.

[6] Abdulla, F.; Qdais, A.H. and Rabi, A. 2008. Site investigation on medical waste anagement practices in northern Jordan. Waste Management, 28:450-458.

[7] Saini, S.; Das, B. K.; Kapil, A.; Nagarajan, S.S. and Sarma R. K. 2004. The study of bacterial flora of different types in hospital waste: evaluation of waste treatment at All India Institute of Medical Sciences (AIIMS) Hospital, New Delhi. Southeast *Asian J Trop Med Public Health*, 35:986–9.

[8] Ross, D. E. 2011. Safeguarding public health, the core reason for solid waste management.*Waste Manag Res.*, 29:779–80. WHO (World Health Organization).2004 "

[9] WHO (World Health Organization). 1999. Safe Management of Wastes from Health-Care Activities. Geneva.

[10] Uddin, J. 2007. Public Health Implications of Hospital Waste Management: A Study on Some Selected Hospitals in Dhaka Metropolitan Areas. An unpublished research monograph submitted to the Department of Sociology, University of Dhaka, Bangladesh

[11] Biswas, Aruna; Amanullah, ASM; Santra, S.C.; Medical Waste Management in the Tertiary Hospitals of Bangladesh: An Empirical Enquiry, ASA University Review, Vol. 5 No. 2, July-December, 2011.

[12] Lee, B.K., Ellenbecker, M.J. and Moure-Eraso, R., (2002). 'Analyses of the recycling potential of medical plastic wastes'.Waste Management, 22(5), pp.461-470.

[13] Hassan, M.M., Ahmed, S.A., Rahman, K.A. and Biswas, T.K., (2008). 'Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh'. BMC Public Health, 8(1), p.1.

[14] BAN and HCWH, (1999). 'An Analysis with a Case study of India and A critique of the Basel-TWG Guidelines', Basel Action Network (BAN) Secretariat Asian-Pacific Environmental Exchange, Medical Waste in Developing Countries.

[15] Radha, K.V., Kalaivani, K. and Lavanya, R., (2009). 'A case study of biomedical waste management inhospitals'. Global journal of health science, 1(1), pp.82-88.

[16] Population and Housing Census 2011, Bangladesh Bureau of Statistics, 2012, Jessore districthttp://203.112.218.66/WebTestApplication/userfiles/Image/Census2011/Khulna/Jessore/Jessore%20at%20a%20glance.pdf (7-6-17)

[17] Hossain, M.S.; Hossain, M.A.; Hassan, K.M.; Medical waste management practice in JessoreTownof Bangladesh: An Empirical Enquiry, Waste Safe 2015, M. Alamgir, K.A.B.M. Mohiuddin, S.M.T.Islam, and M.H. Hasan (Eds.), ISBN: 978-984-33-8695-3,(1-11).

[18]Md. Shameem Hossain, Uday Som , Jinnah Hossain , Md. WasikurRahman and Salma A. Iqbal "Recovery of Alternative Fuel from Thermal Pyrolysis of Medical Wastes", Proceedings of the 4th the International Conference on Engineering Research, Innovation and Education (ICERIE 2017), Paper ID: ICERIE 2017_ 134, pp. 683-688, 13−15 January, SUST, Sylhet, Bangladesh

[19] Moumita, C.,Rahman, M.S. and Rikta, K., 2015. Medical Waste Management System: An Alarming Threat (A Case Study on Jessore Municipality, Bangladesh). Journal of Environmental Science and Natural Resources, 6(2), pp.181-189.

[20] Mondol, U., Hossain, M.S. and Saha, R., 2016 Recovery of Electric Energy from Municipal Solid Waste of Jessore Town Bangladesh.

[21] World Bank, 2002. Health Facility Waste Management Study in Bangladesh. Dhaka

7. NOMENCLATURE

Symbol	Meaning
MW	Medical Waste
MSW	Municipal Solid Waste