Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

The Project Feasibility Study of Electric Power Plant from Waste of MahaSarakham Province, Thailand

Prayoon Wongchantra[1], Kuantean Wongchantra[2], Likhit Junkaew[3], Kannika Sookngam[4], Uraiwan Praimee[5], Surasak Kaeongam[6], Suparat Ongon[7*]

[1,3,4,5,6,7]Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham,Thailand

[2] Srimahasarakham Nursing College, Faculty of Nursing, Praboromarajhanok Institute, MahaSarakham, Thailand

* Corresponding Author :twin_petch@hotmail.com

ABSTRACT

The purpose of this study was to study the project feasibility study of electric power plant from waste of MahaSarakham province, Thailand. The data were collected from primary data by actual recording and secondary data from documents for analysis the feasibility of area and waste state in area, technical, economics and management of solid waste transfer station. The findings revealed that there were the feasibility and appropriate in area and waste state in area, technical, economics and management of electric power plant from waste.

Keywords
project feasibility study; electric power plant from waste; MahaSarakham

Introduction

At present, the countries almost everywhere in the world have increased the population rapidly economic growth, society and politics, the development of the industry. And technological advances make everything changes brought environmental problems especially in urban areas waste quantity rapidly rising from each family practice activities in daily life and solid waste present often contains a material removal and biodegradable difficult, such as plastic, foam, cans, glass, etc. Due to the growth in science and modern technology, production of various articles changed the living conditions of the people must be fast and convenient. Some kind of waste if it is handled or destroyed badly, It may cause harm to public health. Also, factories and factories are vital to the production of toxic waste [1].

The problem of solid waste management is the environmental issues that all parties involved different spot focus and to work together and edit. It is a problem that it will be more severe and more because. It is consequential prosperity, both economic and society continuously, to produce new technology to use in daily life higher living standards and the waste materials and the amount of waste high increase as well. While on the way and the place in garbage disposal is mainly the ratings were sanitary and the efficiency of the agencies responsible for solid waste collection day remained low. The awareness and the consciousness of the solid waste of people in the community is still not satisfied [2].

MahaSarakham province is one problem of waste management hearing, municipal solid waste the amount of waste generated about 400 tons/day. And where used in garbage disposal in the office there are a total of 70. The solid waste problems in provincial happened today, due to the economic and social growth rapidly affected the environmental quality in areas such as the water, soil pollution, air pollution and it is a problem in public health which harm the health of people, such as smell, as a breeding disease in the management of solid waste of administrative organization, MahaSarakham province, also not effective as it should be which is facing a shortage of personnel, the lack of knowledge in solid waste management is appropriate and the conflict in the operation, the technology uses inappropriate. Because at present most agencies will take garbage collected from the community to bulk together on the ground to let the decomposed naturally, including burning rubbish the removal of this method resulted in environmental problems and health of the people. They also found a problem in the supply dump garbage [3].

Because these waste quantities caused domestic increased, as a result of the population increase rapidly. So it is necessary to study how to disposal efficiency and important is to ratings affect the environment. For the technology to be used should be is a technology that can pull energy latent in garbage waste layer used for the benefit of its competition. Technology for application of waste management effectively to its technology which can reduce the mass and volume of waste ratings and must be clean technology, the technology for heating is a technology that can reduce the mass and volume of waste ratings as well [4]. Refuse Derived Fuel (RDF) is the cleanest technology. It is suitable for the production of energy by using solid waste as fuel. The Refuse Derived Fuel (RDF) technology is a form of waste management to be used as a fuel by improving and converting solid waste into solid fuels that have the desired heat, humidity, size, and density properties for use as fuel for electricity or heat. This may be useful in the place where the waste is produced or transported to another location.

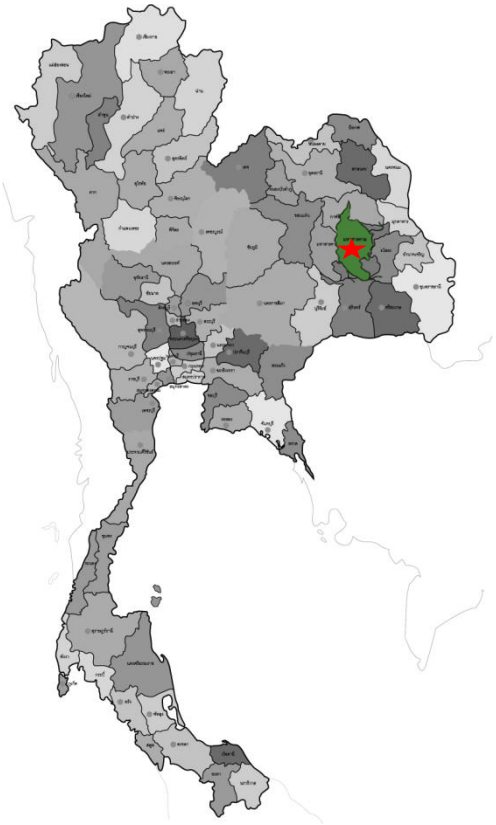
Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

In addition to the problem of solid waste, energy demand is also important because energy is important to economic development and the well-being of humanity, especially electricity this energy is convenient to use and use in all areas both in residential areas, industrial area or even an agricultural area. Therefore, the use of thermal energy generated by burning waste, which is usually left to use as a power source to generate electricity. In order to drive the solid waste management in MahaSarakham to follow the roadmap of waste and hazardous waste management and community solid waste management policy of Thailand to solve the problem of solid waste in the overall of MahaSarakham to be effective and accurate according to academic principles. Therefore, the researcher is interested in feasibility study of the waste electrical power plant project which is considered a project that leads to solving the problem of existing waste and future solid waste by the large amount of solid waste and waste that will come up to be eliminated as renewable energy especially to produce electricity. It would be beneficial to both eliminate and consume electricity to benefit the society.

Materials and Methods

Materials and Methods

1. Study pattern : The feasibility study of the project of power plant of waste, MahaSarakham province was study on the potential, due to project of electric power plant waste rely on the feasibility study is important, especially the possibility of the area and situation of garbage in the area. The possibility of technical power plant waste, the possibility in economics and the possibility of management power plant waste, this is a practice and the value of the project on the investment, and the benefits of the development of the project. This study using the primary data study qualitative research, with emphasis on the analysis of the feasibility of solid waste power plant, MahaSarakham province for management of solid waste efficiency.



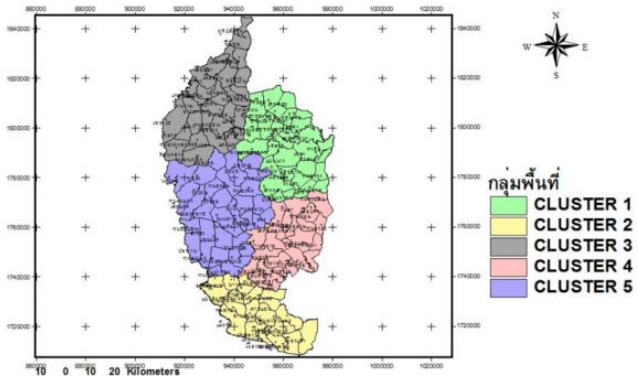


Figure 2. The cluster area of solid waste management of Maha Sarakham province

Figure 1. Map of Thailand

2. Data collection : How to collect data, feasibility study of power plant from waste of MahaSarakham province was to collect information from the actual state by recording and primary data, which analyze information from documents, books, information media as well as other documents related to the waste electric plant project by analysis of the possibility of the area and situation of garbage in the area, the possibility of technical power plant waste and the possibility in economics and the possibility of management power plant from waste.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

3. Data analysis :

1) The feasibility of the area and situation of garbage in the area was preliminary assessment of the area towards the location of the power plant waste by indicating characteristics of the area that is possible or not the store information about the type, quantity waste in the area of MahaSarakham province collected the secondary data or statistical data related to solid waste along with the quantity of waste generated forecast in the future, getting the information that can be used to determine the size of the garbage power plant to support the amount of waste adequately in the future.

2) Technical feasibility of waste electrical power plants MahaSarakham province, it is a technical study to analyze and analyze the planning and management of waste electrical power plants in each technology, the technology is integrated, Sanitary Sanitation Technology, Incinerator technology by process, Refuse Derived Fuel (RDF), Fermentation Technology or Biotechnology, Heat technology Non-oxygenated degradation technology, Incinerator Technology and other technologies.

3) The feasibility of economics, which is considered and analyed of project cost arising from the project, the cost of machinery, the operational costs, including the financial statements consists of financial budget labor cost calculation of asset depreciation, budget and operating costs as an alternative data in decision making and informed decision for planning the operation and to improve things, the changes that occur. This can lead to the effective operation and the yield the most rewarding and other benefits that may arise.

4) The feasibility of management of power plant, garbage, MahaSarakham was the study of the enterprise management and management, management in the power plant waste working process power plant from waste, management of the environment and preventive measures and solving the initial environmental examination for the operation of appropriately and effectively.

4. Conclusion and final report: the data from the concept and the theories related to sum up and write a complete report on the feasibility study of the project of power plant of waste, MahaSarakham province to be in writing the report, the final report.

Result and Discussion

1. The feasibility of the area and situation of garbage in the area

1) The feasibility of size, location area, showed that the project power plant from waste, MahaSarakham province, an area in the establishment of all projects include 34 rai. From the classification of space according to the size of power plant's waste the criteria for selection of the area. The design and construction of power plant from waste and space usage of elements. In the power plant waste for optimal for the establishment of power plant waste to facilitate adequate management area in part as a factory building electricity from garbage truck stop, and other office system with waste to happen in the future according to the concept of the office of the energy regulatory commission Energy Regulatory Commission [5] by land size must be sufficient to the operation current and future expansion, the basic support system infrastructure as well as appropriate. There must be water enough not to cause trouble with other water users in the area, the distance from residential areas enough to not suffered from the noise and smell, annoyed by the distance of not less than 300 meters. The distance from the main road to the plant, distance transportation waste from waste collection area or station stay waste transfer station came to power plants and distance from power plants to power users or connected to the network system of energy.

2) The feasibility of the location of the project site found that the site of the waste electrical power plant project, MahaSarakham province it is spacious, it is adjacent to the road being used for transportation and transportation. This makes it easy to access multiple routes without affecting the traffic in that area for the location of the waste electrical power plant. At present, MahaSarakham is an agricultural area located on the hill according to the concept of Energy Regulatory Commission [5]. Project site selection the design of the construction shall be considered in accordance with the criteria for consideration of the location of the solid waste incinerator, must not be in flooded areas, limitation of geography, hydraulics and ground, must not be in the area for tourism or leisure must not be in the ecological/cultural conservation area and history and not in the raw water conservation area for water supply.

3) The feasibility of the situation in the area, it was found that the waste office of municipal garbage happened about 456.6 tons/day by the power plant from waste, MahaSarakham province can support the waste from MahaSarakham was divided into 4 cluster were cluster 1 (Chiang Yuen district, Chuen Chom district and KosumPhisai district) solid waste quantity about 129.8 tons/day, cluster 2 (Borabue district, Na Chueak district and Kut Rang district) solid waste quantity about 85 tons/day, cluster 3 (Wapi Pathum district and Na Dun district) solid waste quantity about 87 tons/day, cluster 4 (PhayakkhaphumPhisai district and Yang Sisurat district) solid waste quantity about 30 tons/day and center (MueangMahaSarakham district, Kae Dam district and Kantharawichai district) solid waste quantity about 124.8

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

tons/day. This is the location of the waste electrical power plant MahaSarakham province based on the feasibility study of the area and waste situation in the area showed that the site of the waste electrical power plant project MahaSarakham province. It is appropriate and readily available in terms of space needed for the construction of a solid waste electrical plant and the surrounding area of the project area facilitates the construction and implementation of the project, facilitate access to the project without affecting the training and it is safe to drive along with reducing the number of road accidents in the project route and the amount of waste in the area.

The feasibility study of the area and the garbage in the area showed that project location area power plant from waste, MahaSarakham suitability and availability in terms of size sufficient to project construction power plant from solid waste and the surrounding area is conducive to project construction and project development and is suitable to set up the project power plant waste since the project has the potential to support the waste in the future according to the concept of Thiammekha, Ch. [6] said potential, quantity and composition of solid waste the secondary data or statistical data related to solid waste and it is predicted in the future to waste more data can be used to determine the size of the system when power system proper to support the waste and energy production quickly enough. And consistent with the research Chinpirastian, W. [7] it has been found that the waste in TambonSaiKaew municipality is up to 20 tons per day in forecasting based on historical data, it is estimated that in the next 15 years, the amount of waste will increase to 50.64 tons per day old garbage can not handle waste since it has been used for 12 years, it is necessary to find a suitable location for the construction of a sorting and sorting plant and to select the suitable location for further selection. And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, KannikaSookngam, KochokNantasomboon and UraiwanPraimee [8] had studied solid waste management model in Mahasarakhamprovince, found that the research area was made up of 13 districts in Mahasarakham province. The amount of solid waste in Mahasarakham province was found at 379.9 tons per day. There were 39 solid waste management personnel and there are 111 garbage collection trucks. The frequency of solid waste collection was about 115 times per day collected from Monday through Friday. The solid waste management of Mahasarakham was divided into centers: cluster 1: a district waste energy plant (mueng districts), cluster 2 (Chiang Yuen districts), cluster 3(Borabuesubdistrict districts), cluster 4 (Phayakkhaphum districts) and cluster 5 (WapiPathum districts) were a landfill site for waste disposal to be transported to the waste electrical power plant.

Figure 3. Solid waste in MahaSarakham province

2. The feasibility analysis of the choice and technology in solid waste management.

Approach to the technology choice of proper disposal and flexible changes in composition of solid waste energy production and energy consumption system and net energy obtained from the system. The each technology or process is different, and different applications are as follows:

1) Integrated technology system a garbage using principles of management in order to effectively control or reduce the amount of garbage disposal system to go into the hygienic environment by means of destruction, whether it is burning, composting fertilizer or landfill is the main sanitary as remaining amount of waste disposal system to a minimum.

2) Sanitary landfill technology is a sanitary landfill, waste disposal by landfill disposal such landfills need to be sanitized, starting with the selection and design of the area. The use of landfill disposal by sanitary landfill is an uncomplicated process low operating costs. It is a system that, when it is finished, can be used to improve this area in other ways. It is suitable for waste disposal projects located in close proximity to communities.

3) Incinerator technology with gasification (Gasifier) is the process of gasification, which is a combustion that limits the air entering the combustion chamber. It is an organic combustion limited oxygen causes incomplete combustion, which is called fuel gas can be used as fuel high removal efficiency get rid of community waste effectively. There is no heat in

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

the waste disposal process get energy from the garbage, no landfill required. There is not much space in operation but it has a high operating cost.

4) Technology system Refuse Derived Fuel (RDF) is a form of waste management is used for fuel, one of the ways by improving the conversion of waste into fuel and solid, with property in terms of heat value, moisture content, size density and appropriate to use as fuel boiler feed for electricity or heat and there are the elements of both chemical and physical.

5) Anaerobic Digestion (AD) technology is the use of anaerobic microorganisms that degrade organic matter in waste to biogas. The output of waste disposal is biogas that can be used to generate electricity.

6) Thermal process technology is a technology that dramatically reduces the mass and volume of solid waste and in time need less space for disposal than other methods. It is also possible to utilize heat energy as a by-product of the waste disposal process for energy production as compared to other technologies. It can be used to produce steam or generate electricity energy produced by the system. Typically, it depends on the heat value of the solid waste that enters the kiln.

7) Non-oxygenated degradation technology is to use the decomposition process Non-oxygenated wastes in community solid waste management primary treatment: separation of organic solid waste from solid waste or sorting out organic waste and reducing the size of organic waste for decomposition and to ensure the consistency of organic substances to enter the system including to prevent any damage to the system.

So it can be seen that the system technology Refuse Derived Fuel (RDF) is as a fuel with a suitable to build a power plant from solid waste because the technology to transform garbage as fuel system (RDF) by improving and convert the waste into fuel of solid qualifying in the heating value (Heating Value), moisture content, size, and density. It is suitable to use as fuel boiler feed for electricity or heat and there are the elements of both chemical and physical according to the concept of Wongchantra, P. et al. [9] that the feasibility study of technical technical study to analyze the planning and managing system in waste management information frayed. The technology for the production of electricity from waste must be clean technology and environment friendly. And consistent with the research ofThiammekha, Ch. [6] found that the technique can produce power and 4 method using incineration technology is no rostral oxygen. The technology to produce biogas from landfill systems and produce fuel gas from municipal solid waste each technology is the suitability of each different sides. The way of scoring in each of the criteria found; the most appropriate technology for municipal technology is the technology degradation by anaerobic mixed with fuel production from waste residue after compressed garbage fermentation biogas. And consistent with the research ofSawangwong, J. [10] found that the amount of garbage at approximately 450 tons/day which the garbage as an energy source by comparing these 3 core technology used widely is the technology out of the landfill, technology, biodegradation, anaerobic and kiln. And when the environmental considerations found kiln technology affect the environment as much as possible. The lowest is the technology biodegradation anaerobic. It was found that the each technology has advantages, drawbacks differently depending on several factors in the indicator. And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, GamonSavatsomboon, LikhitJunkaew, KannikaSookngam, SuparatOngon, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen. [11]studiedPluakdaeng Sub-district Administrative Organization, Pluak Daeng district, Rayong province, found that the waste disposal site is far from the source of waste. A waste dump truck was established inthe area to effectively remove waste from the area to the disposal facility. The purpose of thisstudy was to study the project feasibility of solid waste transfer station of PluakdaengSubdistrict Administrative Organization, Pluakdaeng district, Rayong province. The data werecollected from primary data by actual recording and secondary data from documents foranalysis the feasibility of area and solid waste state in area, technical, economics andmanagement of solid waste transfer station. The finding revealed that there were the feasibilityand appropriate in area and solid waste state in area, technical, economics and management ofsolid waste transfer station.

3. The possibility of economics

The feasibility study of economics and value investing research to find the cost of the machine. The operational costs, including operational cost, the cost of maintenance and other costs etc., to calculate the total cost of the project to assess the value of all of the project, it was found that from the analysis of the cost estimation of solid waste incinerator system. The 1 category building which contains work outside the building construction building construction landfill and ash, construction of pond water construction of pond water quality monitoring. The 2 category specific system, including category specific system and private gardens at 3 control construction cost job type buildings 1,274,546,700 million is investment of government and private sector participation contributes to invest in infrastructure. The operation of the government will effectively have targeted working plan period of completion and budget must be used operation practice and have goals the objectives set forth. The investment would be worthwhile in the public sector, not focusing on the economics of monetary purse because government investment is not for profit, but it will be worth the benefits and satisfaction to the people.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

Therefore, the investment in the establishment of a waste electrical power plant, MahaSarakham province. Therefore, the cost effectiveness in the field of useful and satisfied can help reduce one operating cost or be utilized without wastage, pollution reduction make the country clean. As well as the appropriate impact on the environment in the power plant from solid waste to occur least. According to the concept of Jaiboonma, T. [12] said that the decision to choose a project for investment depends on the value of the project. The value of the project is measured by the comparison between the benefits and costs of the project. If it is possible to identify and measure the benefits and costs of a project as a quantitative measure, the project analysis will be based on a cost-benefit analysis of social and environmental dimensions. And consistent with the research of Vichadee, S. [13] ; found that the cost of the power plant, including the main investment, machinery, equipment, production, land and construction costs. The main income from fees in solid waste management, the waste recycling and the income from electricity and regions.And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, SurasakKaeongam, LikhitJunkaew, KannikaSookngam, SuparatOngon, ChonlatitPhansiri and AkkharadechOncharoen. [14]found that finance and economics : the IRR is 3% and the NPV is 187,678,311.38 baht, which has a payback period of 13 years and 1 month, which shows that the 8 MW. It is possible to invest in construction being economically feasible and feasible to invest because of the return on investment of the project in the appropriate range of investment. And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, KannikaSookngam, LikhitJunkaew, SuparatOngon, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen. [15]found thatThe budget in solid waste management was 182,178,902 baht per year whichdepartment was the possibility of creating waste management to produce refuse derivedfuel(RDF). The waste caused a 402.97 tons / day used in production is the refuse derivedfuel(RDF).

4. The possibility of management power plant waste

A feasibility study on the management of the power plant from solid waste the organization, management are studied. Management within the waste electrical power plant work process of waste electrical power plant environmental management safety in operation and measures to prevent and correct the initial environmental impact for proper and efficient operation makes it possible to determine the appropriate management organization model when an electric power plant from solid waste occurs. No additional staffing and staffing is needed because the project can be carried out efficiently.

So, when a power plant from waste management, management in power plant of waste, The working process of waste power plant management of the environment, The safety system in practice and preventive measures and solving the initial environmental examination to make the plant more effectively. According to the concept of Kiatmanaroch, T. [16] said that management of the environment and safety system in practice, the precautions and fix the initial environmental examination, the management of garbage transfer station that there should be preparation personnel prepare check measures and control trash waste. The smell of insects and disease vectors in order to prevent troubled the health, including the record amount of waste from the source. And consistent with the research ofKhieodara, M. &Khieodara, R. [17] found that the government's policy, the goal, measures and approaches in the operation management of solid waste the community continuously, the guidelines for the management of solid and hazardous waste in the river make action plan to support local government organizations to obtain financial support that only enough to dominate the local administrative organizations. The local administrative organizations should perform campaign for the kitchen in the community each bearing solid waste reduction. Also, there should be a garbage separation supply tank for waste and garbage truck that tightly enough. And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, SuparatOngon, LikhitJunkaew, KannikaSookngam, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen [18] found that project of solid waste management effectively with the production ofrenewable energy changing from the area of no use was the value added of land use by theimpact on the well-being of society or community was very low. The employment of the peoplein the community and surrounding area led to generate income, flow of money in the economy,help the economy and the income of the community better, quality of life and well-being ofhelping people in the community better as well as improves the utilities of the community. It isgood for the economy and the society of overall space. It also includes measures to prevent,correct and reduce environmental impacts. The project can be implemented with minimalenvironmental impact and the planning of public participation to implement environmentalimpact assessment and environmental measures to cover more. And consistent with the research of PrayoonWongchantra, KuanteanWongchantra, ChonlatitPhansiri, LikhitJunkaew, KannikaSookngam, SuparatOngon, SurasakKaeongam and AkkharadechOncharoen [19] studied the feasibility of internal management station and found that the project washigh form of administration and internal management of solid waste transfer station environmental management and the system safety in work and social responsibility of solid waste transfer station, the precautions and fix the initial environmental examination in order to make the management in solid waste transfer station was appropriate and effective.So the solid waste transfer station project of Mahasarakham, there were the feasibility of the area and the situation of waste in the area, the feasibility of technical transfer station, the feasibility in economics and the feasibility of management transfer station.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

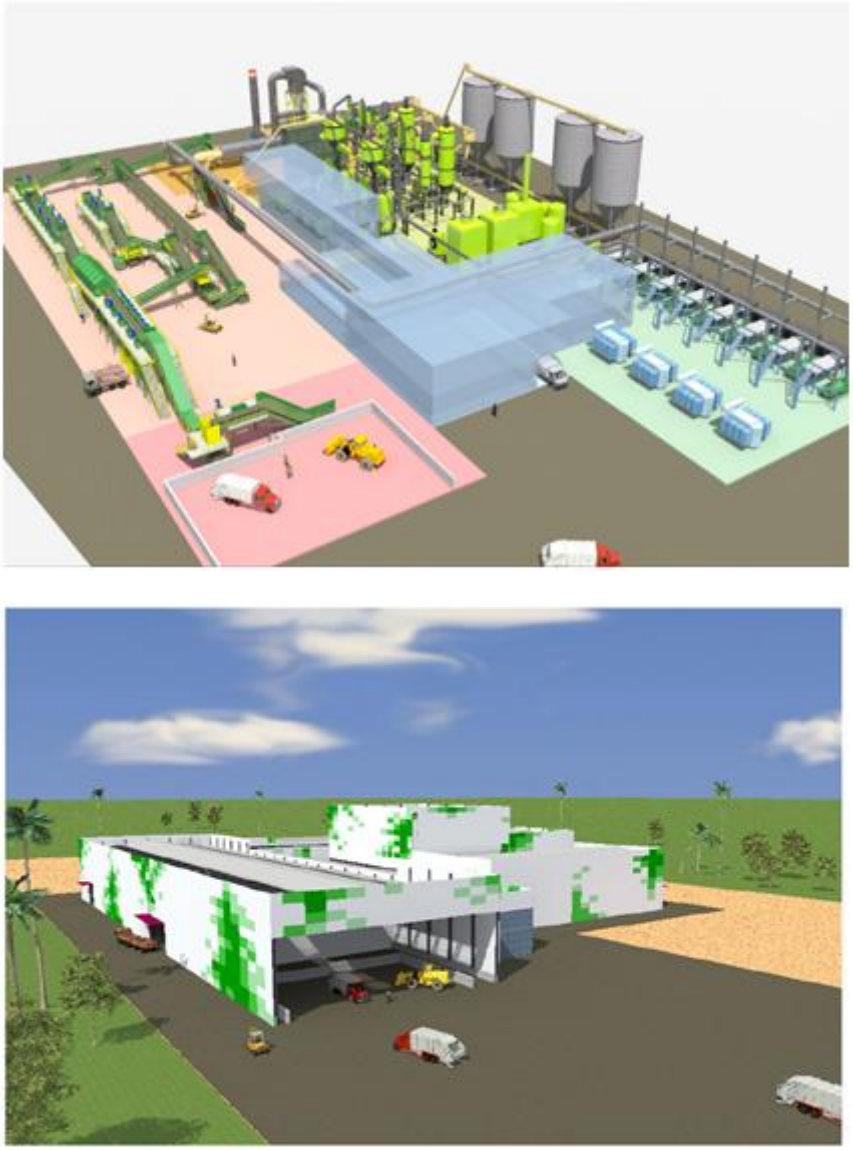


Figure 4. Electric power plant from waste

Conclusion

1. The feasibility of space situation in the area and found that the feasibility of the project area, the possibility of the appearance of the area. The possibility of local waste situation are appropriate and the availability of sufficient space for the construction of power plant waste

2. The feasibility analysis of alternative technology and waste disposal technologies that convert waste into fuel (RDF) is a fuel suitable to generate power from garbage. In order to process waste as fuel efficiency increases and minimal environmental impact.

3. The feasibility of economic investment in the establishment of power plant waste, MahaSarakham province the break-in happened helpful. It can reduce the cost of operating one or can be utilized without waste to reduce pollution make a clean house as well as the appropriateness of the impact on the environment from power plant waste to a minimum.

4. The feasibility of managing waste from power plants that manage solid waste from the power plant as the organizational model and management, management of solid waste from the power plant, electricity from waste processing plant environmental management security in practice and preventive measures and preliminary environmental impact is appropriate and can be implemented effectively.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 5, 2021, Pages. 5081 - 5088
Received 15 May 2021; Accepted 20 May 2021.

Acknowledgements

This research project is financially supported by Mahasarakham University and Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University.

References

[1] Kaikangwan, Ch. (2001). *Public Participation in Waste Removal: A Case Study of WarinChamrap Municipality* (Master' s thesis). National Institute of Development Administration, Bangkok.

[2] Chukeit , C. (2005). *The Strategic administration of solid wastes : case study of tambolDankhumtodMunicpalit, Nakornratchasimaprovice*. (Master' s thesis). Khon Kaen University, Khon Kaen.

[3] Wongchantra, P. et al. (2014). *Solid waste management of Local Administrative Organization Mahasarakham province.* Mahasarakham :Mahasarakham provincial administrative organization.

[4] Kreeso, P. (2012). *Testing of RDF gasification for power generation by a downdraft gasifier*. (Master' s thesis). King Mongkut's University of Technology North, Bangkok.

[5] Energy Regulatory Commission. (2016, April 21). Retrieved from http://www.erc.or.th/ERCWeb2/ Upload/Document/%.pdf.

[6] Thiammekha, Ch. (2013). *The feasibility of electric power production from waste of Kanchanaburi province*. (Master' s thesis). King Mongkut's University of Technology Thonburi, Bangkok.

[7] Chinpirastian, W. (2010). *Feasibility Study of Garbage Separator; Case Study in Sai Kaew Municipality, Soi Dao District, Chanthaburi Province*. (Master' s thesis). University of the Thai Chamber of Commerce, Bangkok.

[8] PrayoonWongchantra, KuanteanWongchantra, KannikaSookngam, KochokNantasomboon and UraiwanPraimee. (2017). The Model of Solid Waste Management in Mahasarakham Province. *Conference Proceedings on The 4th EnvironmentAsia International Conference " Practical Global Policy and Environmental Dynamics" Bangkok, Thailand.* June 21-23, 524-535.

[9] Wongchantra, P. et al. (2016). *Feasibility study report for solid waste disposal station project Wapi Pathum district and Na Dun district, Mahasarakham province.*Mahasarakham : Foundation of Environmental Education.

[10] Sawangwong, J. (2010). *Energy and Economic Analysis Including Environmental Externalities of Municipal Solid Waste Power Plant*. (Master' s thesis). Chiang Mai University, Chiang Mai. 158-159.

[11] PrayoonWongchantra, KuanteanWongchantra, GamonSavatsomboon, LikhitJunkaew, KannikaSookngam, SuparatOngon, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen. (2017). The Project Feasibility Study of Solid Waste Transfer Station of PluakdaengSubdistrict Administrative Organization, Pluakdaeng district, Rayong of Thailand. *International Journal of Agricultural Technology*. 13(7.2), 2143-2160.

[12] Jaiboonma, T. (2007). *A Cost Comparison Study of a Combined Cycle Power Plant (with the Green House Gas Cost) and a Hydroelectric Power Plant.* (Master' s thesis). Kasetsart University, Bangkok.

[13] Vichadee, S. (2005). *Feasibility study of electricity generation from Chiang Mai Municipal solid waste.* (Master' s thesis). Chiang Mai University, Chiang Mai.

[14] PrayoonWongchantra, KuanteanWongchantra, SurasakKaeongam, LikhitJunkaew, KannikaSookngam, SuparatOngon, ChonlatitPhansiri and AkkharadechOncharoen. (2017). The Project Feasibility Analysis of a Waste-Electric Power Plant of Kamalasai Sub-district Municipality, Kamalasai district, Kalasin province. *International Journal of Agricultural Technology*. 13(7.2), 1773-1789.

[15] PrayoonWongchantra, KuanteanWongchantra, KannikaSookngam, LikhitJunkaew, SuparatOngon, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen. (2017). The Project Feasibility study of Solid waste Management in Kalasin Local Governance Organization to Produce Refuse Derived Fuel (RDF). *International Journal of Agricultural Technology*. 13(7.2), 1791-1803.

[16] Kiatmanaroch, T. (2002). *Site screening of municipal solid waste transfer station by analytic hierarchy process*. (Master' s thesis). Khon Kaen University, Khon Kaen.

[17] Khieodara, M. &Khieodara, R. (2009). *Solid Waste Management in the Area of Kanchanaburi*. Ramkhamhaeng University, Bangkok.

[18] PrayoonWongchantra, KuanteanWongchantra, SuparatOngon, LikhitJunkaew, KannikaSookngam, SurasakKaeongam, ChonlatitPhansiri and AkkharadechOncharoen. (2017). Initial Environmental Examination Study Report: Project of Effective Waste Management with Production as Renewable Energy of the Mahasarakham Provincial Administrative Organization. *International Journal of Agricultural Technology*. 13(7.2), 1805-1820.

[19] PrayoonWongchantra, KuanteanWongchantra, ChonlatitPhansiri, LikhitJunkaew, KannikaSookngam, SuparatOngon, SurasakKaeongam and AkkharadechOncharoen. (2017). The Project Feasibility Study of Solid Waste Transfer Station of MahaSarakham, Thailand. *International Journal of Agricultural Technology*. 13(7.2), 2125-2142.