International Conference on Mechanical and Industrial Engineering
ICMIE2022
November 15-17, 2022 Tripoli-Libya

Kinetic Modelling Investigation For Organic Energy Resource Application

Abdulhakim A. Agll
Mechanical& Industrial Engineering
University of Tripoli
Tripoli, Libya
a.Agll@uot.edu.ly

Abdalbasit A. Galy
Mechanical Engineering Technology,
Higher Institute of Comprehensive Profession- Alhadpa Alkhadra
Tripoli, Libya
abdgaly@gmail.com

***Abstract*--The power demand rises year by year due to inhabitants is rising, and shortage of the energy supply induce many developers looking out for alternative energy source and new technology to cover energy lack resources. Using the local sustainable energy clean and friendly to the environment as alternative fuels and renewable energy to mitigate the consumption and greenhouse gas emissions. The investigation aimed to optimize an approach for reducing rate of energy and some assumptions are accomplished for reasonably saving method. Study data collected to assess the waste enthalpy for Municipal Solid Waste (MSW) from 1997 to 2009, in Zawiya Libya. The burner can consume about 38,250 kg/h as a capacity of total solid waste collected as MSW over the coming 15 years. Basic investigation energy surge to confirm the quantity of MSW to select the suitable furnace work out with full capability over the instant. The most important objective to investigate the ability combine heat power (CHP) with power generation (PG) by using Rankin power steam cycle. The PG system produce around 7.9 MW for electricity mode. And with CHP mode the outcome results 3.4 million m^3/year of potable water and provide 4.13 MW of electricity. Finally, the power plant for CHP mode is greatest approach to improve energy saving with the optimum combination of heat production and electricity generation.**

Keywords*--Thermoelectric generator, Waste-to-energy technologies, Waste management, Hybrid system, Sustainability, Bioenergy; Value addition, Organic Rankine cycle.

I. INTRODUCTION

Over the last 200 years, people have become extremely exceedingly in need of power which make it to excavation available of the set on. Early for more than 400 years ago the nearly all power source delivered by the human force, waterflow, windflaw or fire energy. The wind strength generate power to run the barges and windmills. The Water flow turn waterwheels. And the Fire did used for cooking and warmed a home. Muscle power (human or animal) did just about everything else. All these power bases consequential as of the sunlight, meanwhile sun power control airstream and rain, help for grew the plant to feed the creatures and human. All these power bases remained correspondingly every cycle time each year, in the meantime blowing air wind, help to grow the trees and crops. Nearby 1800, the people start to extract power from coal mined out of the ground. Then 1900 we began to drill for oil and natural gas. Through 1950 the people start to extract power from "crude oil" needed mostly changed the older power origin excluding for waterwheels [1].

Currently, there are a huge quantity of solid waste due to increasing the population rate. Even lifestyle in top and best countries as industry or growing nations, even large or in minor towns, or are wealthy neither needy, entirely kind of people lead to generate trash. Since many years ago, the industrial countries (ICs) had enormous amount of waste as local resources. In few days ago, most of all energy resources where been now no more fixed [2]. The key for smart ICs is to reduce the quantities of waste produced. These subjected to the country, sort of civilian district, inhabitance, city standard, education, style of life besides of course the income. The quantities of solid waste produced is hard duty in minor secluded schemes from categorized from MSW or reutilizing and on the road to recovery resources. Furthermore, the renewable power generation besides transportation for main power stand identical wide because restricted procedures over in attendance. Thus, the rules remain endorsed in the direction of usage of limited power available, as thorough incineration of MSW include heat saved and reduce the mitigate greenhouse gas releases [3]. To reduce the huge amount of MSW need to burn it and utilys high heat technology to process. In addition, to use the wasted heat and convert it to mechanical work/or electricity required many thermal processes to absorb energy from the burner to heat exchanger as steam generator (Boiler) in Rankin Power cycle [4]. The mastre goal of an incineration system is minimaing the MSW.

However, The heat generated from burner is local sustainabile energy with the high quility and reseanable price as essensial cost. Therefore, not fair to match with the high heating source from burning fossil fuel.

Influence of contamination stands as a reason to consider effect behind burning MSW plant. To decrease the methane emission by using this heat recovery from landfills and fossil fuels [5]. The value of heat absorbed despite carried out be based on MSW ratio of produced to be as carbon fuel and thermal efficiency process to change the picture of the energy from heat to mechanical or electrical. The characteristic and activities of people have main effect because of MSW generate local alternative energy resource, the significant materials of MSW origin green power [6]. However, influence the solid waste assets directed at assembly estimate in addition composition were considered for supporting the investigator to achieve an optimum environmental protection for waste policies to succeed the sufficient design to decrease pollution emission [7].

This research objected to study the gains of power to generate heat by burning MSW in incineration, this study desire solicits to the big cities like Zawiya, Libya. This research selects the solid waste burning as alternative energy source and aimed at CHP (Combine Heat Power) production. However, initial step classifies the solid waste elements were assessed, and estimate the low heating value, to get the measure of the possible total energy will recovery. Then, the study of thermal incineration procedure to be done for estimate the possibility to use this heat gained for distillation and generate electricity. The classifications of the system for changing biomass to high heat source [7-8]:

1.Thermochemical conversion:
2. Biochemical Conversion
3.Chemical Conversion

II. POINT OF RESEARCH

Easily distinguishable the MSW is controlling issues to make it better by its specific. In addition, those one and the same ultimate distinctives placed together city of Zawiya into extreme portion as suitable city to investigate. In quality, city of Zawiya stands placed at north-western part of the country on direction (32°45′08″N 12°43′40″E) over around 114 km^2, with beautiful beach close to Sabratha city, it is about 40 km west of Tripoli city the capital of LIBYA at north part of Africa. Zawiya be located one of the modern cities at western part and is the center of Zawiya where most population density (Fig. 1). The winters average high and low (18-8 ºC) and hot summers average high and low (32-21 ºC), define the climate in Zawiya-Libya as regular of the Mediterranean weather [9].

Fig. 1. Place of Zawiya city – on Libya map [9].

Regarding to the 2020 planning Libya National Statistics Office, the city of Zawiya has 351,306 residents, which being the one of the highest city population densities compare to some counties, 1,100 residents each km^2. Cover power needs through single control electric power station, feed by provided crude oil and gas power cycle. As an important, the electric generation systems consume a big part to impact greenhouse gas releases and in the reduced the bills as will. However, the economy elevates the electricity utilization, which is major using residential refrigeration applications besides heater coil utilizations, though around are not at all HVAC ventilation devices; extreme significant to maximize network more than enough. Currently, discission maker design strategies to increase local alternative energy bases as a portion of the CHP recovery, however this extremely limited through some aspects. Furthermore, to take advantage of programs still face environmental restriction problems.

Since Zawiya city -Libya is in the north and has limited water resource to provide water supply to the end user, and low precipitation is annually 0.380 m [10]. Where the top ruler uses to bring the potable where the Sahara is back in the country, which is it cost a lot of money. This is put the electricity generation in the priority for costumer in the place. Moreover, solid waste control must take a completely construct mapping plan, the organization became necessary due to high volume of solid waste produced per capita. The average is 2 lbm/person /day, this value of MSW produced in Zawiya which is nearly similar to the world public typical (for each individual Daily 2.2 lbm) [10].In addition, Zawiya

consumes approximately equal magnitude from solid waste produced for each individual Daily in place of the similar country metropolis and nearly of international metropolis examples; Tarhouna, Banigazy, Pahang State (Malaysia), Mashhad (Iran), Moron (Cuba), Chengdu & Nanjing (China), Ankara (Turkey) the amount of waste produced per capita/day for mentioned cities are 1.89, 2.2, 2–2.25, 1.88, 1.86, 2.35, and 2.1 respectively [11]. Numerous metropolises in other nation generate less than value of solid waste per individual Zawiya city. Indicated overhead and with it Zawiya city Libya is planning to find an incineration plant required as case of investigation, established ongoing MSW information to develop a thermodynamic and burning as a concept on incineration idea with heat recovery. this research explains the integration of water resource control with dynamic use of local alternative MSW as heat supplies. The Fig. 2 shows flowchart of MSW.

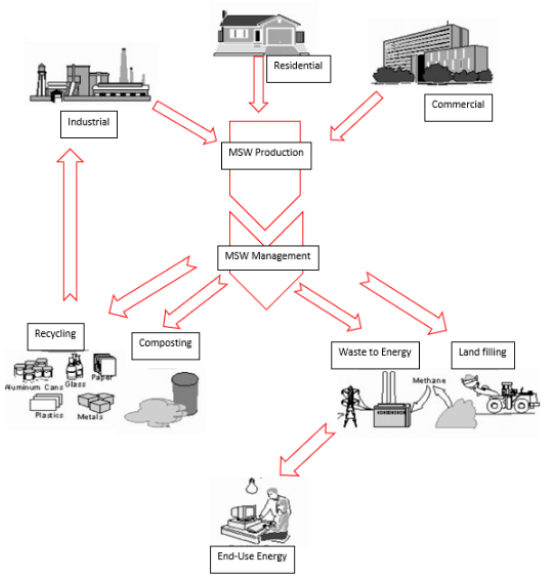


Fig. 2. Flowchart for production and control for MSW [7].

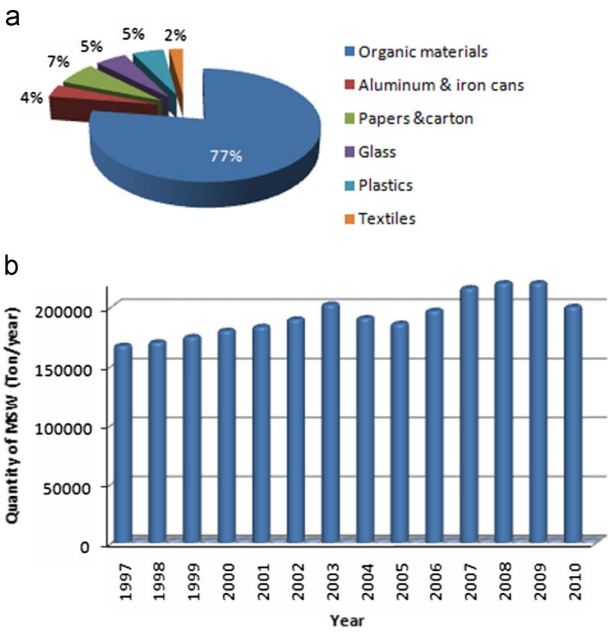
III. INVESTIGATION METHOD

production and control procedure of a city solid waste. Also, it is illustrating the steps of generation MSW and electricity end user. The plan show that need to be items the MSW elements one by one to contrast the quality of the solid waste categories for regrouping. Furthermore, those elements are considered essential during the incineration procedure, due to utilizing it as an input energy addition calculation.

A. MSW study

Study the collected data for MSW of Zawiya-Libya and estimate quantities contains information from domestic private activities, as residential, commercial, and industrial waste. The Department of Information Bureau (DOIB) 2012 inspection provided information collected as surveys. The commercial and industrial flow solid waste data defined from works study taking place structure of the similar flow as identical cities and nation, such as Tarhouna, Banigazy, Pahang State (Malaysia), Mashhad (Iran), Moron (Cuba), Chengdu & Nanjing (China), Ankara (Turkey) [10]. Fig. 3a show up the component of the Zawiya-Libya MSW. However, the latest update for MSW configuration estimated around 85% from the overall solid waste produced through 2003 - 2006 from residential solid waste [11]. In the fig. 3(a) illustrate the peak amount of solid MSW portion in the study find out is organic waste (food) [12]. The values of local MSW control policies and plans stand toward: (I) reduce solid waste production, (II) Increase trash reprocessing besides recycle, then (III) guarantee protection too globally complete dumping solid waste. The local solid waste control be subject to on the total efficiency and productivity of municipal organizations, and the volume of in control municipal the system. Combined MSW organization is one of the all-inclusive methods to global and supply control which is developing after placed the idea of maintainable progress. The long period professionally controls of MSW pale combined MSW organization center. The sustainable way goal of combined MSW control is to decide with the making waste in a globally and commercially. The combined MSW organization scheme contains four keys of developments subsequent in nothing left-over. Previously all procedures of the waste necessity to be collected and organized. The first procedure is to improve minor ingredients which need an access to recycling amenities. This development also essential and satisfactory categorization. Another development is the organic treatment of biological materials [10]. In case, biological wastes can be elements to provide fertilizers AP (Aerobic process); anaerobiotic breakdown technique AP could utilize toward change biological MSW mad about molten composts. Biogas, as result of the anaerobiotic absorption, may stand in the direction of form power. In addition, other method of procedure remains heating recovery directing arranged conducts toward decrease the capacity of MSW by burning of mixed solid waste, burning of itemized elements of the solid waste flow which attitudes Refuse-Derived Fuel (RDF), where extricate the materials from domestic services single item like plastic and paper. This method helps to emphasize schematic analysis for pre-heated toward steady solid waste then cut the size of solid waste for dumping in landfill. Similarly, this development mothed knew for example a waste valorization technique by resources of fertilizer and methane biogas construction. However, individual residual of this procedure is fly ash where throw out popular

landfill. Obligation, the place of landfill lead greatly reduced. Furthermore, the issues of biogas and the pollution of shallow and water revisor could minimized. Around combined solid waste schemes might not cover all quatern developments designated overhead which might affect in residual materials. The whole combined solid waste-controlled scheme consists of: (i) Materials assortment(ii) Solid waste repossession services(iii) Incineration and heat saving(iv) Organic conduct of methane from MSW(v) Junk of ultimate sluggish residual waste. Surely know the landfill is still the end point of final outstanding from processing of any MSW elements consecutively technique. As an alternative of systematic surplus remain complete, the residual material of solid waste stands only deliberate wastes. Therefore, the lifetime of landfill



could stretch [11].

Fig. 3(a). Main percentage component of MSW recorded in Zawiya City. (b). Recorded MSW produced at Zawiya-Libya amounts in tones [12].

The prediction of the solid waste produced for next few years is key to organize the magnitude of any incineration system. typically, the present, there are no investigation to predict and evaluate of the

Indorsed Outline MSW for Zawiya-Libyan city. In addition, the solid waste produced in 2009 it was 300 × 105 kg. Consequently, the upcoming solid waste produced can be forecasted with this information. With year on year procedure period of the burner created on standards provided by the heat recovery agency where expected to stand 8000 hr. In interpretation of the 2009 solid waste recorded information, remains principals to a 22,000 kg/h as mass flow rate. For an unforeseen change of mass flow rate increase 7% over recorded value flow rate going to design aspect [11], this quantity of solid waste mass flow rate become 26,150 kg/h. Fig. 3(b) revealed the collected solid waste data produced through 1997 – 2009 [12].

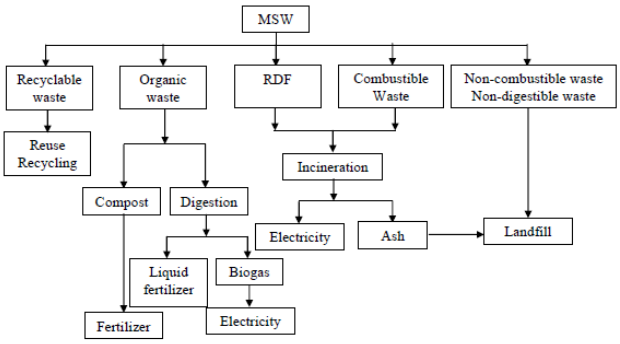


Fig. 4 Chain of a Combined MSW flowchart

The latter knowledge remained conventional with the solid waste produced for each person; a pointer typically useful to find potentials assessments. The recorded statistics keep on reserved as of the Zawiya-Libya residents (development proportion 3.1%) [12], So, the anticipated inhabitants peak at 362,197 residents in 2031. The annual MSW produced projected becomes after 16 years is 35×10^7 kg or 43,150 kg/h, designed for 8000 h of working time/year. This quantity determination be used for the following designs.

B. Heat recovery and Incineration

This investigation acknowledges toward the burning procedure, assessing this flue smoke besides the intake environment temperature essential in the direction of full combustion. Altogether information as of the previous study besides were used on the increasing load executed through the Commands. Considered the updated quantity of MSW to be burned by development Incineration, that is the firing scheme, valuable for the solids waste to make sure totally burned out. MSW is essential low-level procedures designed to scheme [13].

The sessional of applying heat and mass protection for process useful to investigate physical appearance stayed used to discovery the production capacity of smokestack gas produced, the high temperature produced, and the contribution air. The Steam Power Generation (SPG) stands a recognized knowledge subsequently the primary 1900's. A huge quantity of SPG systems take placed, mostly for ground as heat exchanger, MSW energy saving and CHP applications. The heat and power generated from biomass combustion Using biomass with low heating value as the fuel is a challenge today, Rankin power plant steam cycle illustrated in fig 5. The solid waste burner investigation deliberates the

entire combustion of the principle pure substances - hydrogen (H), sulfur (S), and carbon (C) [12]. Consequently, through essential configurations and physical characteristic from previous works [13] the scheming initiates through approximating the pertaining required quantity of oxygen for full burning in space, Fig. 6 explain processes of solid waste incinerator and flue gas treatment.

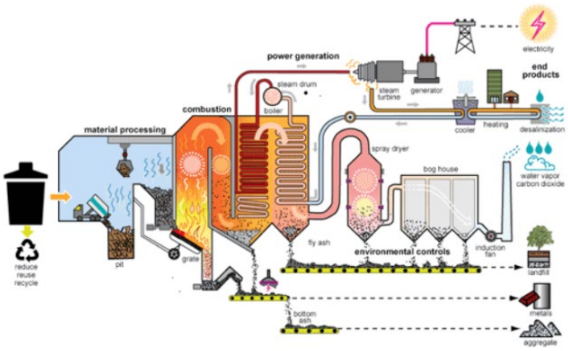


Fig. 5. A mass-burn waste-to-energy plant Rankin cycle [14]

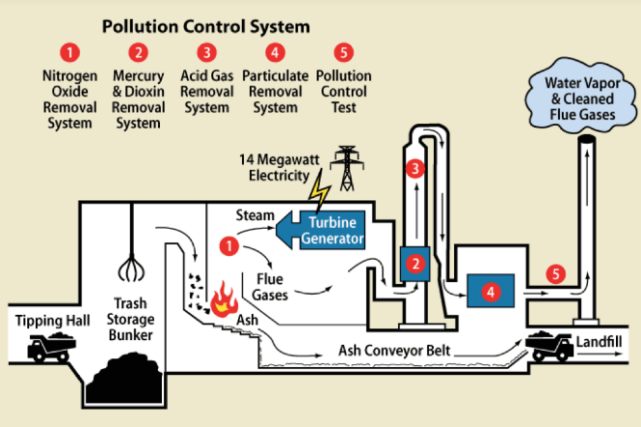


Fig. 6. Basic method of transfer solid waste to heat [15]

Popular the European Burning Instruction [15] in consequent necessities of were evaluated the temperature of the flue smoke would stand measured between (800–1100) ºC and retain avoid establishment doxenitoin at bottom [14] where increase more than the peak will cause residue melding dilapidation of the fractur substantial [6, 16] besides the O^2 percentage from smokestack flow is ≥ 6% [13]. By using the Equation formula (1) [14] is informal to estimate the flue gas capacity (Zfg, (m^3)) and intake air required (e, (m^3)). The solid waste besides supply air stands not reacted the other gas as released in the molecular form [15].

$$Z_{fg} = Z_{CO2} + Z_{H2O} + Z_{SO2} + Z_{N2,MSW} + [0.79Z_{air,theo}(1+e) + 0.21eZ_{air,theo}] \quad (1)$$

Where: Z_{CO2}, Z_{H2O}, Z_{SO2}, $Z_{N2,MSW}$, $Z_{air,theo}$, and $Z_{air,theo}$ are size of CO_2 (m^3), size of H_2O (m^3), size of SO_2 (m^3), N_2 satisfied trendy the solid waste (m^3), besides calculated size of air (m^3) individually. Through the energy gained during the incineration low heating value (LHV) stands produced the difference of the flue gas total heat content ($\sum\Delta H_{fg}$) can be epitomized by Equation (2) then the heat equilibrium throughout burner [13].

$$\begin{aligned}\sum\Delta H_{fg} &= \Delta H_{O2} + \Delta H_{N2} + \Delta H_{H2O} + \Delta H_{CO2} + \Delta H_{SO2} \\ &= LHV \times \times \dot{m}_{MSW} - \xi\, LHV \times \dot{m}_{MSW} \\ &= LHV \times \dot{m}_{MSW}(1-\xi) \quad (2)\end{aligned}$$

Where: H_{O2}, ΔH_{N2}, ΔH_{H2O}, ΔH_{CO2}, ΔH_{SO2}, LHV, $\dot{m}_{MSW}$, ξ, are heat content of O_2 in flue gas (kJ/s), heat content of N_2 in flue gas (kJ/s), heat content of H_2O in smokestack gas (kJ/s), heat content of CO_2 in flue gas (kJ/s), heat content of SO_2 in smokestack gas (kJ/s), heat missing in place of a relationship of the entire released, besides solid waste little energy rate (kJ/kg), individually. At that point, the function among C_p (Heat capacity) then temperature remains a third-degree polynomial [17], where stands utilized on the way to compute the exit the flue smoke temperature, through the equation program to solve Equation (2) [6]. Around stand numerous attempts besides mistake repetitions toward calculate the H_2O heat add for (steam generator). Uncertainty of yearly typical temperature remains 22 ºC trendy Zawiya-Libyan and an burner capacity of solid waste mass flow rate is 4.33×10^4 kg/h, as achievable to compute the amount of raw considerable or statistics deal with quantity then amount of molecules per hour aimed at each single components, the quantity for Material, Over-all steam (H_2O), Over-all C, Over-all H_2, Over-all O_2, Over-all N_2, Over-all S, besides the Residue remain 98 kilo gram per hour, 13.10, 8.25, 1.51, 5.38, 0.27, 0.04, and 6.0 correspondingly [16].

The flue smoke temperature development investigation resolute aimed at quatern dissimilar principles of intake air (e) in place of showed in table I. Correspondingly, assessed the entire heat gained since the burning aimed at the heat content modified in the computations is 89.9%, the 10.1% which is the energy loss [7, 17]. Additionally, the intake of calculated air fulfills entirely previous discussion standards, it could be accomplishment 51.9% flat till take full advantage of the possible for heat gained.

TABLE I. THE RESIDUAL GAS TEMPERATURE PERFORMANCE EVALUATION

Excess of air (e), (%)	Oxygen in the chimney gas, (V_{O2}/V_{fg}) (%)	Temperature, T (°C)	Enthalpy variation, -ΔH (kJ/kg)
51.2	6.0	1045.2	8432.5
58.4	6.5	1021.8	8432.5
65.7	7.0	1000.4	8432.5
72.9	7.5	9986.7	8432.5

The energy gained by using of the MSW as fuel essential be utilized for the steam generator system with the opportunity generate electricity, heat, or provide both as a combined plant. To avoid influence wet steam problems PG and (CHP)

systems generally usage the Rankine power plant. However, by using 2nd law, energy balance, and the thermal Ɪ] to calculate the actual electric and heat energy. Moreover, there pressure loss in the steam generator then in the heat exchanger assumed to be too small and perhaps canceled from calculations. The inlet and outlet situations are (4.0 MPa; 440 ºC), (0.0101 MPa; 46 ºC) one-to-one of the condensation expansion to calculate the possible aimed at work energy which done by the system. By evaluate the vapor quantity stream amount in place of the initial phase; then, calculate the turbine power. The generator performance stands calculated once transmission power-driven from turbine to electrical generator and power-driven to feeding the power on site via the established methods [5, 14].

IV. DISCUSSION AND RESULTS

The outcome of vapor movement rate, electric energy get it from the system, generator performance, Power-driven spent in place, Total thermal productivity, net energy generated, and work done stand 67.3 x10^3 kg/h, 9.12 MW, 95 %, 2.97 MW , 23.47 %, 4.13 MW, and 7.9 MW respectively. The overall cycle efficiency is measured to assure the heat rejected that is removed through the condenser.

The heat gained from burning will lead to reduce the amount of fossil fuel spent for the electric generation system at Zawiya-Libya. consequently, the energy saved can be utilized for desalination sea water system, however of multi effect distillation (MED) and cut investment budget. multi effect distillation reduced electric consumed, then lesser technique temperature liken to the multistage flash technique.

The heat extracted ratio (HER) was used to estimate a characteristic used up amount of 10 kg/kg of extract vapor [18]. This discussion respect by way of the lowest vapor required then latent proceeding HER amount aimed at development system, regarding in the direction of the amount of H_2O stands treated for entirely heat gained was utilized to reduce temperature MED system. Considered a small amount of steam that condensing system working at pressure and temperature condition 0.035 MPa and 72.68 ºC [17].

The RO (reverse osmosis) system is spent 4.77 kWh/m^3 as the real typical heat add per m^3 of H_2O distilled and it is turn out to be 2 kWh/m^3 in this MED system. Next, the thermal efficiency of the Zawiya PG system (32%), the technology roughly provides 0.75 L/m^3 of distilled water is possible to reduce fossil fuel spent [18]. Additionally, this CHP could reduce quantity of fossil fuel used about 2.9 barrel/h, to provide approximately 5.4 x10^6 m^3 of H_2O distilled /year produced from CHP. Moreover, the steam is mostly subtilized for PG by in height value of heat to be gained from the trough work done by the turbine rotor in the CHP plant, and the remaining heat could be fit into energy developments comparable multi-effect distillation. Nevertheless, the vapor removal to provides the multi-effect distillation MED outline and the sub-cooled steam as a residual from the expansion is reduced, in the instance of an abbreviating expansion. In the previous situation, the valuation of the stream amount of H_2O distilled then the PG energy in arrears the equivalent technique mentions previous for the vapor extracting [6,21].

The amount of heat recovery from CHP system was achieved named as principal heat recovery [20]. The full power and heat gained by means of a combined heat power system compared to the quantity of the heat needed successively one by one for the energy saved and the heat saving with the object of the CHP capability exchanges [22]. Finally, the accomplished results for together the backpressure technic and enhanced the saturated statute for the turbine system exit in the tables II and III

The endorsement of combined heat power system for the turbine pressure technic and multi-effect distillation scheme may reduce consumption of the fuel about 9.7 barrels per hour and 2.9 x10^6 m^3 of H_2O were distilled/year by the multi-effect distillation scheme as an another scheme of the reverse osmosis scheme. enhanced the saturated statute for the turbine system exit through vapor removal, these information determinations remain 18.7 barrels/h and around 3.3x10^6 m^3/ year, correspondingly. The municipal solid waste produced in Zawiya-Libya can deliver a substantial participation to reduce gas emission that comes with power generation effect as 3 cases in this research. Increasing the power usage or to electricity supply for fitted of the reverse osmosis system provide to significant main heat recovery through using enhanced the saturated statute for the turbine system exit with steam removal to generate electric energy [21-24].

TABLE II. TURBINE PRESSURE TECHNIC AND MULTI-EFFECT DISTILLATION.

Property	(4 MPa)	Units
Volume of water desalinated	3443.1	10^3 m^3/yr
Gain output ratio	12.0	kg_{dist}/kg_{steam}
Thermal energy available	21.5	MW
Mechanical energy	7.7	MW
Turbo-alternator efficiency	95.0	%
Electric power consumed in the plant	1.5	MW
Electric power produced	7.2	MW
Primary energy savings	23.6	%
Net electric power	6.13	MW

TABLE III. TURBINE SATURATED EXIT AND MULTI-EFFECT DISTILLATION.

Property	$\dot{m}_{ST,ext} = 75\% \times \dot{m}_{ST}$ (4 MPa)	Units
Volume of water desalinated	2244.9	10^3 m^3/yr
Thermal energy available	15.1	MW
Mechanical energy	7.2	MW
Turbo-alternator efficiency	95	%
Electric power consumed	1.5	MW
Electric power produced	7.3	MW
Primary energy savings	15.4	%
Net electric power	7.13	MW

Zawiya-Libya spent around 5.3 x10^6 m^3/year, so if used in a multi-effect distillation system then about 45% of the total drinkable water can produced. Also, the outcome might lead to control the existing reverse osmosis scheme to desalt sea water. Produce electric energy and to distill sea water simultaneously by combined heat power system epitomize the greatest scheme. The clean water distillated by the optimized technique could contribute to cover the grow up both the water requirement, short of increase the electric demand, Also, the system development to deliver the Zawiya-Libya power. Besides, the setting up of the saturated turbine through condensation exit remains a developed for power generation.

V. CONCLUSIONS

The research presents to recommend an alternative resource to provide the electricity and potable water for Zawiya-Libya city through available materials of MSW. The seawater desalination technic and Rankin energy cycle as a system motivation be located at Zawiya-Libya produced by high heating energy supply from MSW incineration. In addition, the combined heat power system designed to produces the heat required the water disrelated process needed each year or single mode for clean power generation to the metropolis. The study of heat recovery from MSW by utilizing the combined heat power system on consumed energy. Accordingly, the heat produced from burning MSW is managed to decrease and cut-off petroleum consumption, for the meantime the fossil fuel burned is too small for this scheme. The CHP system is optimized to mitigate gas emission, and fossil fuel consumption. The multi-effect extraction scheme put top the water request growth, which will happen in near future due to inhabitants' growth in Zawiya-Libya. In closing, the incineration system provides Zawiya-Libya opportunity to preserve a huge capacity from fossil fuel and biofuel utilized as high heat resource to produce power, enhance the heat provided, and mitigate Green House Gas (GHG) emissions. The scheme which stands CHP system with turbine force technic can deliver 9,432.5 m^3/d of potable water and multi-effect distillation with an extra electricity generation around 4.13 MW, and for the second model, possible to delivery power to the city around 7.9 MW (PG).

ACKNOWLEDGMENTS

Significantly, without my family nothing of this might take place. My parents, who offering their support with making Doaa and kind communication every week–despite my individual restricted commitment to my duties. With their own generous of humor, have been nice and loyal to me forever. Also, current position at University of Tripoli College of Engineering, Mechanical& Industrial Engineering Department for their support.

REFERENCES

[1] Abdulhakim Agll, and John Sheffield. Study of energy recovery and power generation from alternative energy source. Case Studies in Thermal Engineering 4(2014)92–98.

[2] Pervez Alam, Mufeed Sharholy, Neyara Radwan. Energy generation and revenue potential from municipal solid waste using system dynamic approach (2022) Chemosphere, 299 (134351), ISSN 0045-6535.

[3] Md Wahid Chowdhury, S.M. Muyeen Recycling slaughterhouse wastes into potential energy and hydrogen sources: An approach for the future sustainable energy

[4] Bioresource Technology Reports 2022Volume 19, 101133 ISSN 2589-014X.

[5] Furkan Kartal, Uğur Özveren. Energy and exergy analysis of entrained bed gasifier/GT/Kalina cycle model for CO2 co-gasification of waste tyre and biochar

[6] Journal of Fuel part 2 Volume 331 (2023) 125943, ISSN 0016-2361

[7] Wilgince Apollon, Sathish-Kumar Kamaraj, Improvement of zero waste sustainable recovery using microbial energy generation systems: A comprehensive review, Science of The Total Environment, 817 (2022), 153055. ISSN 0048-9697.

[8] Mingzhang Pan, Xiaoting Chen, Xiaoya Li. Multi-objective analysis and optimization of cascade supercritical CO2 cycle and organic Rankine cycle systems for waste-to-energy power plant. Applied Thermal Engineering 214 (2022); 118882. ISSN 1359-4311

[9] Zawiya, Libya - Wikipedia, 2022.

[10] Quddus Tushar, Joao Santos, Guomin Zhang. Recycling waste vehicle tyres into crumb rubber and the transition to renewable energy sources: A comprehensive life cycle assessment. Journal of Environmental Management 323 (2022) 116289. ISSN 0301-4797

[11] A. Gebril1, A. Omran, A. Pakir, H. Abdul Aziz, Municipal Solid Waste Management In Zawiya (Libya): Current Practices And Challenges. Environmental Engineering and Management Journal 9 (2010) 1289-1296.

[12] O. Abdelnaser, S. Alsadey, M. Gavrilescu, Municipal Solid Waste Management In Bani Walid City, Libya: Practices And Challenges. Journal of Environmental Management and Tourism II (2011) Issue 2(4).

[13] EGA, (2008), Information on solid waste management issues in Zawiya city, Libya. Environmental General of Agency, On line at: http://www.environment.org.ly/index_en.htm.

[14] Biomass explained Waste-to-energy (Municipal Solid Waste) US. Energy Information Administration.

[15] An Independent Engineering Evaluation of Waste-to-Energy Technologies Thomas Stringfellow 1.13.2014.

[16] Meraz L, Domínguez A, Kornhauser I, Rojas F. A thermochemical conceptbased equation to estimate waste combustion enthalpy from elemental composition. Fuel 2003; 82:1449-507.

[17] Afzal Husain Khan, Eduardo Alberto López-Maldonado. Municipal solid waste generation and the current state of waste-to-energy potential: State of art review. Energy Conversion and Management 267 (2022) 115905, ISSN 0196-8904.

[18] Moshood Akanni Alao, Olawale Mohammed Popoola. A novel fuzzy integrated MCDM model for optimal selection of waste-to-energy-based-distributed generation under uncertainty: A case of the City of Cape Town, South Africa. Journal of Cleaner Production 343 (2022) 130824. ISSN 0959-6526.

[19] Jechan Lee, Kun-Yi Andrew Lin. Hybrid renewable energy systems involving thermochemical conversion process for waste-to-energy strategy Chemical Engineering Journal 452, Part 2 (2022) 139218 ISSN 1385-8947

[20] Jie Ma, Xudong Song, Ben Zhang. Optimal design of dual-stage combined cycles to recover LNG cold energy and low-temperature waste thermal energy for sustainable power generation. Energy Conversion and Management 269 (2022) 116141 ISSN 0196-8904

[21] . Aqua Swiss. MED - Multi effect distillation. Economical and technological advantages over MSF and multi stage flash ; 2010 [accessed May 2022], http://www.aquaswiss.eu/images/solutions/whitepaper.pdf

[22] Zobaidul Kabir, Mahfuz Kabir, Nigar Sultana, Chapter 8 - Waste-to-energy (WtE): A potential renewable source for future electricity generation in the developing world. Editor(s): Imran Khan, Renewable Energy and Sustainability, Elsevier (2022) Pages 203-226 ISBN 9780323886680

[23] Noor, Z., Yusuf, R., Abba, A., Mohd Din, M. overview for energy recovery from municipal solid wastes (MSW) in Malaysia scenario. Renewable and Sustainable Energy Reviews 20 (2013) 378–384

[24] Peiyuan Pan, Weike Peng, Jiarui Li. Design and evaluation of a conceptual waste-to-energy approach integrating plasma waste gasification with coal-fired power generation. Energy 238, Part C (2022) 121947 ISSN 0360-5442