Methodology

3.1 Introduction

In this research the methodology was used to investigate and examine the thermal treatments especially the pyrolysis of the medical waste.

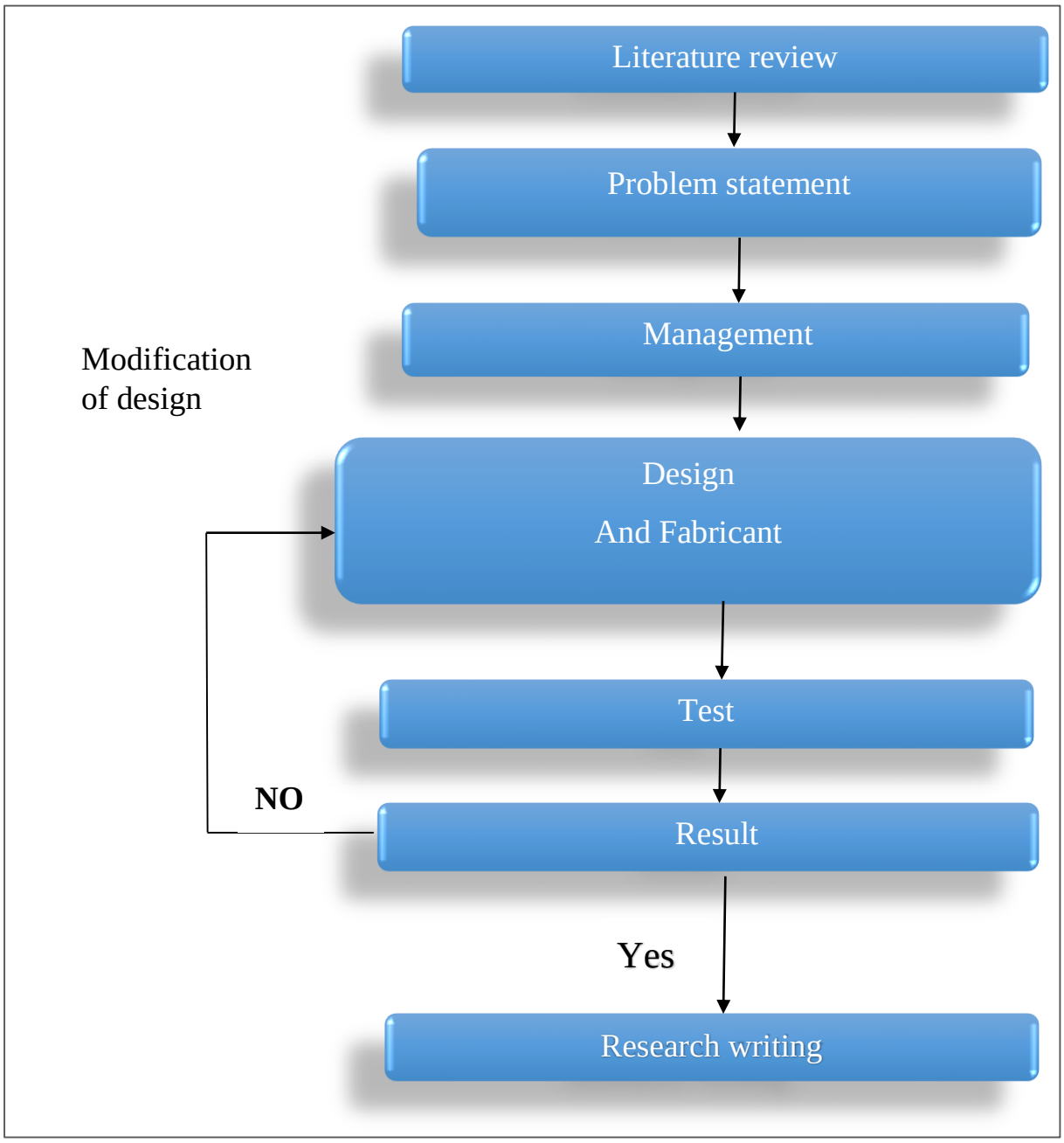

Figure 3.1 show the flow chart of work

3.2 Management in Khartoum

The work was carried out at Khartoum due to it is the capital city of Sudan and the healthcare facilities are spread all around this city.

Site visits were conducted to support and supplement information gathered in the survey. These visits were helpful in obtaining information about common practices in the management of the wastes.

The forms contain information on the generation of waste and main aspects of segregation, collection, internal and external storage, transport, treatment of the medical waste management and final disposal.

The data also collected from various private and government hospitals responsible for collection and disposal of medical wastes and from health officials.

3.3 Apparatus description

The device which use in this study is consist of many components as follows

- Pyrolysis reactor
- Cyclone separator
- Water cooler
- Pipes
- Thermo-couple
- Gas analyser

3.3.1 Pyrolysis Reactor

The reactor which use for pyrolysis must has been high melting point to resist the high temperature at which it exposed, so in this test we use such device that has the same property.

The medical waste particles located in the centre of the reactor and in the upper part pyrolysis volatile leaves the reactor zone as explained in below figure.

Figure 3.2 show the pyrolysis reactor.

3.3.2 Cyclone separator

Is gas cleaning device that utilize the centrifugal force created by spinning gas stream to separate particles from the gas. The gas flow is forced to flow the curved geometry of the cyclone, while the inertia of the particles in the flow causes them to move toward the outer wall.

In the cyclone, the particles in the spinning gas stream move progressively closer to the outer wall as they flow through the device.

The particles-laden gas is entered tangentially to the cyclone .the particles are forced to the wall by centrifugal force and then fall down the wall by gravity at the bottom of the cyclone the gas flow reverses to form the inner core that leaves at the top.

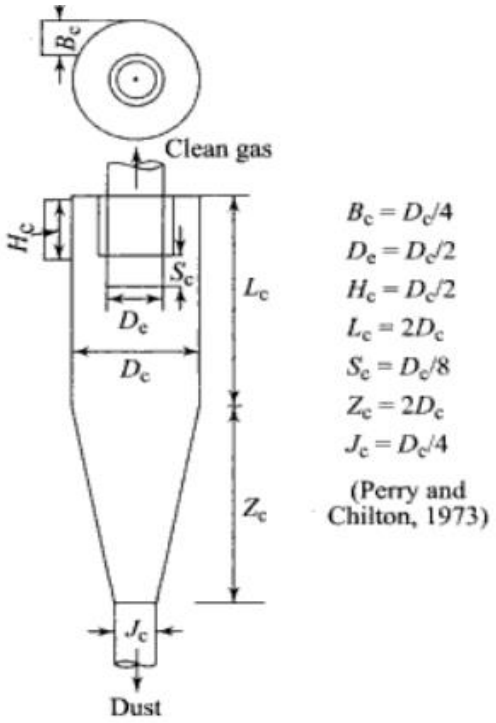

Figure 3.3 show design of the separator.

Lc= length of cylinder

Zc = length of cone

Bc = width of entrance

Hc = height of entrance

Jc = diameter of dust exit

De = diameter of gas exit

Dc = diameter of the cylinder

Se= the length of the bar below the gases stream

Figure 3.4 show the designed separator.

3.3.3 Water Cooler

The water cooler that has been used in this experiment is water tank which is use for heat exchange between supply water and hot flue gases which coming from the reactor passing through the cyclone separator in order to condense the condensable gases and let the rest (incondensable gases) to flow, So the main purpose of this device is to clean the syngas by reject the condensable gases.

Figure 3.5 show water cooler

3.3.4 Pipes

The purpose of pipes is to transfer flue gases through the all component of the system and it must resist high temperature, steel pipes are used and the diameters of them are (1.50 inch-0.5 inch). The length of the pipes as follow (15cm from the reactor to the cyclone – 35cm from cyclone to the water tank).

3.3.5 Thermo-couple

To measure the temperature while the thermal treatment is run thermo-couple type-k is used. This couple is measure temperature above 1200℃.

Figure 3.6 show the thermo-couple type k

3.3.6 Gas analyser

The kane automotive range of emission analysres covering rhe models Auto 4-1/MID & Auto 5-1/MID has been designed to be used on petrol, LPG or CNG powered engines. The gases which this analyser can get is HC, CO_2, CO and O_2.

Figure 3.7 Gas analyser

3.4 Experimental setup

The pyrolysis experiments were carried out in a pyrolysis reactor on batch mode basis. A fixed amount of dry waste sample was packed in the reactor. For the experiments with available of pure air. The decomposition of waste sample

was evaluated at various temperatures (350 ℃ and 360 ℃) and retention time (60 min. and 120 min).

This study was carried out in government and private hospitals in Khartoum. The experimental steps was carried out on Sudan University of Science and Technology during March 2017- October 2017, depended on the various methods of data collection.

3.5 Treatment and Disposal of Medical Waste

Investigations were also made to know if the facilities incinerate wastes, the size of the incinerator present in the health facility if existed, and if the incinerators were in good operating conditions.

The survey asked the hospitals about the method they used for treatment and disposal of medical waste. The following are the results from the answers to the section in the survey requesting information on treatment and cost of disposal of the wastes.

All the hospitals and health care centres in Khartoum are not allowed by law to carry out onsite medical waste treatments this is to safeguard against pollution.

Consequently, there are no onsite incinerators, all types of medical waste treatments are conducted off site by contractors. The final disposal of the medical waste is implemented through one private company specialized on waste disposal.

3.6 Materials and pre-treatments

Medical waste is one of the dangerous category of waste inside or outside Sudan. In this study medical waste was supplied from Best Care hospital after we take permission from the only private company responsible of medical waste

treatments and disposal Saudi Sudanese Gulf Environmental Protection Company (SEPCO). Infectious medical waste were chosen as experiment materials for they are popular in medical wastes. In order to make the sample heated sufficiently, we split the infectious medical waste to small pieces as we could, before conducting experiment. All samples were dried in oven at 95 ◦C for 30 minutes, so the moisture of sample was removed to minimize the interaction in the pyrolysis phase of particle conversion. The dry process repeated for 3 days until it become 100% dry approximately.

Figure 3.8 show the medical waste which have the treatment

3.7 slow pyrolysis procedure

The slow pyrolysis was performed in system prepared locally in the collage.

In a typical experiment, a briquette of medical waste was introduced into the reactor at room temperature (350℃), and after making an air tight closure, heating was started to one of the above mentioned temperatures.

The following steps were followed experimentally:

Step 1

A total of 9.07 kg of the infectious medical waste was loaded in the reactor.

Step 2

After loading the medical waste, the reactor was closed and the heating system was turned on.

Step 3

The temperature start increasing with time, during that the vapour was beginning to evaporate after 5 minutes.

Step 4

The total time that required for the experiment was 120 minutes and the temperature was measured at end of the experiment and it was 345℃ inside the reactor.

Step 5

After 120 min. the burner was stopped then the sensor of gas analyser was put on the gas outlet and the results were recorded.

Step 6

The experiment was repeated twice and two results were carried out at same condition for each experiment.