3 MATERIALS AND METHODS

3.1 Overview

The purpose of the research is to investigate the influence of torrefaction process on physical and chemical properties of biomass. In the present chapter, the details of materials involved and related experimental setup are discussed in detail. This chapter is divided into four sections. Section 3.2, 3.3 and 3.4 deals with the materials used for the present studies and the preparation of sample, respectively. The details on the experimental setup for torrefaction process are discussed in section 3.5. Figure 3-1 shows the overall process of the experiment.

Figure 3-1: Overall process of the experiment
3.2 Materials

There are three types of biomass involves in this study which are Empty Fruit Bunch (EFB), Palm Mesocarp Fiber (PMF) and Palm Kernel Shell (PKS). About 3kg of each types of biomass were collected at Palm Oil Plantation LCSB Lepar Hilir, Gambang.

3.3 Preparation of samples

Raw biomass that collected from Lepar Hilir were prepared before it can be used in torrefaction experiment. Figure 3-2 shows the samples of raw biomass before drying process. The samples were dried in an oven under temperature 105°C for certain time until the moisture content in the sample is less than 10%. Figure 8 shows the raw biomass before drying process.

![Figure 3-2: Raw biomass before drying process](image)

Next, the sample were grounded in order to reduce the size using grinding machine and blender. Figure 3-3 show the grinding machine that used for grinding the raw biomass. After the grinding process, the raw biomass were sieved to get the desired size about 2 to 4 mm for the experimental purpose using sieve shaker. Figure 3-4 shows the sieve shaker that used for sieving the raw biomass. Each tray of the sieve shaker has different size. For this study, only four tray was used which sized 4mm, 2mm, 1mm and also bottom tray.
Then, after desired size of raw biomass was obtained, the heating value of raw biomass was determined using oxygen bomb calorimeter. The heating value can be determined as the energy released as heat when a compound undergoes complete combustion with oxygen. Figure 3-5 shows the bomb calorimeter that used for determine the heating value of raw and torrefied biomass.