Effect of Rotational Speed on The Production Capacity of Bamboo Charcoal Particle Sieving Machine

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Abstrak

Tujuan dari penelitian ini adalah untuk mempelajari pengaruh kecepatan rotasi pada mesin pengayak untuk kapasitas produksi ayakan partikel arang bambu. Mekanisme pengayakan sedang dikembangkan. Ayakan menggunakan 100 dan 200 mesh dengan kecepatan rotasi digunakan 120 rpm, 150 rpm dan 180 rpm selama 15 menit untuk mengayak 50 gr partikel arang bambu. Dalam penelitian ini, proses pengayakan dapat menghasilkan kapasitas produksi ayakan partikel arang bambu 18,78 gr pada 200 mesh dengan kecepatan rotasi 180 rpm.

Kata kunci: kecepatan rotasi, kapasitas produksi ayakan, mesin pengayak, partikel arang bambu

Abstract

The aim of this research is to study the effect of rotational speed on the sieving machine for the production capacity of bamboo charcoal particle sieve. A new sieving mechanism is developed. The sieves used 100 and 200 mesh with rotational speed used 120 rpm, 150 rpm and 180 rpm for 15 minutes to sieve 50 gr of bamboo charcoal particle. In this research, the sieving process can produce production capacity sieve of bamboo charcoal particle of 18.78 gr at 200 mesh with rotational speed of 180 rpm.

Keywords: rotational speed, production capacity sieve, sieving machine, bamboo charcoal particle

1. INTRODUCTION

Carbon is a unique and indispensable element in our world, the 6th element in the universe, the 4th element in the solar system and the 17th element in the Earth's crust [1]. It has been estimated that the relative abundance of carbon is between 180 and 270 parts per million [2]. Remarkably, carbon is also the second most common element in the human body after oxygen [3], thus making about 18 percent of a human's body weight. Although, elemental carbon is sparse on the earth's crust with barely 0.2% of the total mass of this planet [1] [2] [4], however, its function is incredibly essential as it can form bonds with other light elements and itself. As a result, the ability of carbon to paved the way on which chemistry and biology have been expanded, and eventually making the wonders of life to occur [3]. As such, carbon science is very trendy today and in the field of nanoscience, materials science, engineering and technology, carbon nanostructures are identified to comprise of different low-dimension allotropes of carbon including graphite, activated carbon, carbon nanotubes, and polyaromatic molecules [5] [6] [7] [8] and graphene [9] [10] [11]. This is the reason why researchers from various scientific backgrounds are very curious about this carbon material by considering the key role they have played in many new advanced technologies [12].

Bamboo has high potential as a substitute for many lignocellulosic and non-lignocellulosic materials in various application capacities because of their chemical composition and physical properties. Bamboo is also a source of quality activated carbon, which can be found in the medicine, foods, chemical and metallurgical industries [13]. Bamboo charcoals are multi-functional materials pyrolysed from bamboo under anaerobic

conditions. During this pyrolytic process, bamboo is converted to stable charcoal. Bamboo charcoal serves as a substitute for wood charcoal or mineral coal and has been reported to possess absorption capacity which is six times that of wood charcoal of the same weight [14]. Hence, bamboo charcoal is a suitable absorbent. Studies have also revealed their uses as absorbent for dyes [15] [16], heavy metal [17] [18], organic pollutants [19] and other substances [20] [21].

Carbon-based nanomaterials, such as bamboo charcoal nanoparticles has been used in many fields, such as in microorganism [22], composites [23] [24] [25] [26], and Biomedical [27]. Bamboo charcoal nanoparticles synthesized with High Energy Milling (HEM) method on the particle size reduction using shaker mill [28] [29]. Particle size distribution is the most important parameters of characterization of nanoparticles [30]. Determination of particle size distribution using a sieving machine before the shaker mill process in order to obtain homogeneous particles.

Sieving is known as one of the most useful, simple, reproducible, and inexpensive methods of particle size analysis, and belongs to the techniques using the principle of geometry similarity. It is considered the only method for giving a particle size distribution based on the mass of particles in each size range. Particle size is defined by the sieve aperture by which a particle may, or may not, pass through [31].

Among all the elements of the sieving operation, sieve blinding is considered as the most important and direct controlling factor. Sieve blinding occurs when particles block up and lodge in the sieving mesh. It reduces the effective transfer area on the surface, resulting in reduction of sieving rates (sieving performance or capacity) and the degree of sharpness of particle separation (sieving efficiency) [31][32] [33].

With regard to the sieving process, either for industrial separation of solid particles or as a laboratory method in size analysis, a stack of sieves of decreasing mesh size, also known as a sifter cascade, is often used [34]. The sieve stack is typically mounted on a device that provides vibration or shaking to achieve the movement of particles in relation to the sieve surface. For example, in flour milling, breakage of particles is always followed by separation. A plansifter, a stack of sieves of decreasing mesh size that separate particles by size, is the main equipment used for this separation purpose. On a laboratory scale, standard ASAE procedure for particle size analysis of particulate materials also requires use of a stack of sieves [35]. For simplicity, this common sieving process is referred to as the stacked or cascaded sieve method. It features separation of particles in a coarse to fine order by a single operation.

Numerous studies reveal, the comparison of the reverse sieve method and the stacked sieve method for sieving performance and efficiency using flours made from soft white and hard white wheat, hulless barley and medium grain rice [36]. The design and manufacture of electromagnetic sieving machines that convert electromagnetic energy into mechanical energy aims to assess the powder particle size and granular particle distribution of agricultural products, Garri. The choice of Electromagnetic Sieving Machine is to increase the amplitude of the oscillation and thus reduce the sieving time [37]. The developed of an easily operated and user friendly sieving machine to sieve pound of yam flour in a process plant [38].

This research is for the development of sieving machines to get the maximum bamboo charcoal particle sieve production capacity. Sieving machine uses a new mechanism of the shaker model. One factor is to get the maximum sieve production capacity with rotational speed. The aim of this research is to study the effect of rotational speed on the sieving machine for the production capacity of bamboo charcoal particle sieve. The sieves used 100 and 200 mesh with the rotational speed used 120 rpm, 150 rpm and 180 rpm for 15 minutes to sieving 50 gr of bamboo charcoal particle.

2. METHODS

Different types of sieve shaker have been created. In this research, a new sieve shaker mechanism is developed (Figure 1(a)). The sieve shaker mechanism is obtained from rotational motion changed to translational motion by connecting rod (Figure 1(b)). The speed of the motor can be controlled and the length of the stroke is determined by the length of the connecting rod.

(a)   (b)

Figure 2.1. Materials used in this research (a) sieve shaker (b) connecting rod.

The sieve was made from stainless steel with 100 mesh and 200 mesh. The contents of the 100 mesh sieve are 50 gram of bamboo charcoal powder. The sieve, pan, cover and bamboo charcoal are put into the oven for 5 minutes at 200 degrees Celsius. The process of sieving bamboo charcoal with rotational speed uses 120 rpm, 150 rpm and 180 rpm for 15 minutes. In this study, the number of repetitions was done ten times. The best data that meets the standard deviation is displayed as the sieve production capacity.

3. RESULT AND DISCUSSION

The sieve production capacity at 100 mesh are shown in Figure 2. The largest weight of 26.27 grams is produced by the rotational speed of 180 rpm at 100 mesh. Weighing 25.85 grams and 24.09 grams is produced by 150 rpm and 120 rpm at 100 mesh. It can be seen that an increase in rotational speed of 120, 150 and 180 rpm causes the weight of bamboo charcoal powder to be sieved to become more.
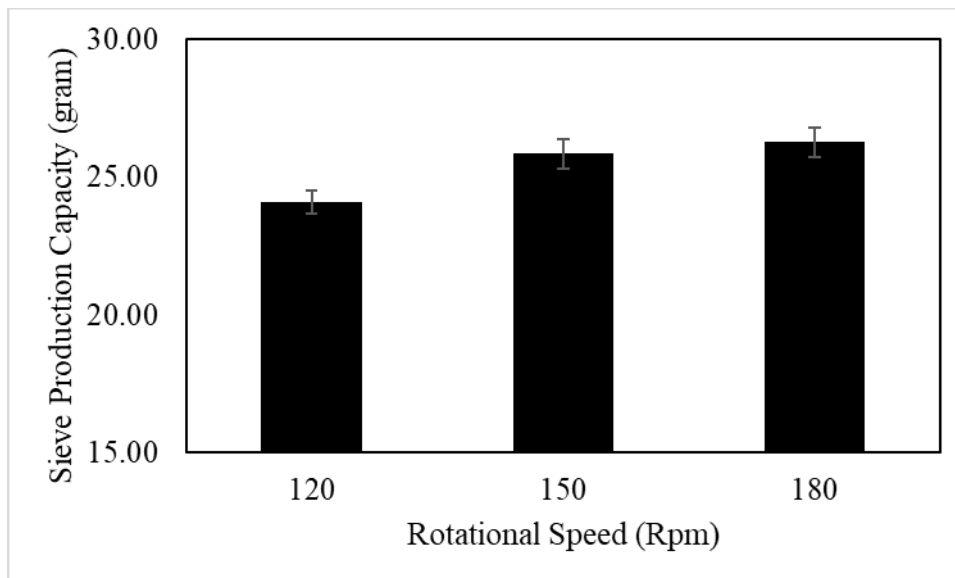

Figure 3.1. Sieve production capacity at 100 mesh

The sieve production capacity at 200 mesh are shown in Figure 3. The largest weight of 18.78 grams is produced by the rotational speed of 180 rpm at 200 mesh. Weighing 18.05 grams and 17.71 grams is produced by 150 rpm and 120 rpm at 200 mesh. It can be seen that an increase in rotational speed of 120, 150 and 180 rpm causes the weight of bamboo charcoal powder to be sieved to become more.
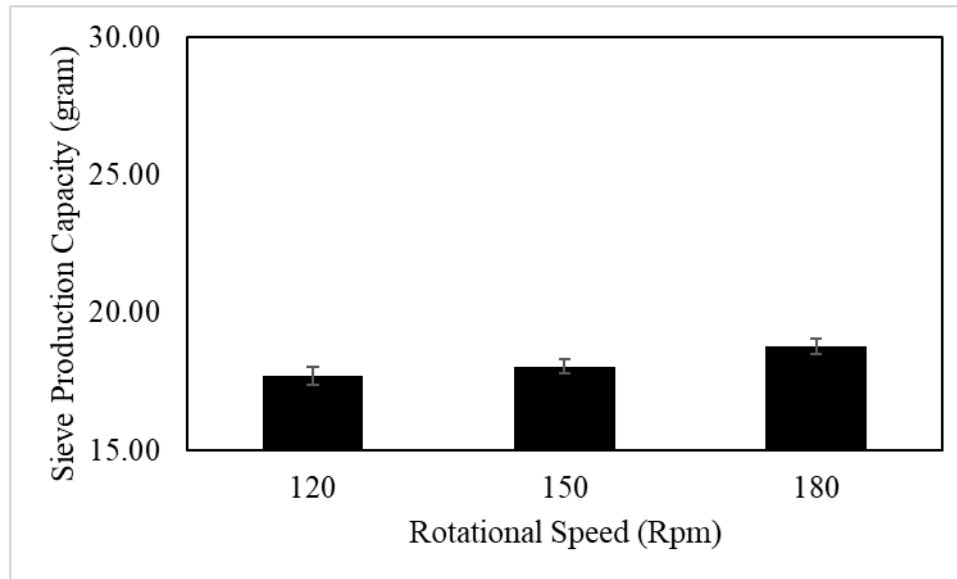
Figure 3.2 Sieve production capacity at 200 mesh

The moisture level of a particulate material affects such physical properties as adhesion and stickiness, which in turn influence freedom of particle movement during the sieving process [34]. For a given sieving condition and given particulate material, there will be a moisture level that allows maximum freedom of particle movement.

4 CONCLUSION

The sieving machine can be used to sieving a bamboo charcoal powder with a production capacity of 26.27 grams at 100 mesh and 18.78 grams at 200 mesh with a rotational speed of 180 rpm. It seems that bamboo charcoal is a potential source to produce nano particle of pure carbon.

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