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Original Research Article

Performance Evaluation of A Stud Grinder for Roasted or Bone Dried Grains/Cereals Using Particle Discretization Analysis with a Vibrating Sieve.

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Abstract: The performance of a stud grinding machine is done with particles size discretization analysis with sieve to validate its preference for bone dried or roasted materials. The discretization analysis is done by grinding five samples of 2kg roasted guinea corn at different speeds - 600,900,1200,1500 and 1800 rpm using a variable speed 2Hp electric motor under 1:1 speed ration respectively. The products resulted were discretized into particle sizes with a vertical throw electromagnetic vibrating sieve and the grinding efficiency is a function of speed. The particles generated as x-rayed by the results of vibrating sieve which has seven sets of sieves 10,15,20,25,30,35,and 40 µm with a collector that collects particles less than 40µmfrom the set of the speeds reveals that as the speed increases the finer (smaller) the particle size and particles whose sizes are lesser than 40µm were obtained to suggest that higher speed favours the grinding efficiency of a stud grinder.
Keywords: Study Grinding Machine, Performance Evaluation, Particle Discretization, Speed Of Machine Rpm, And Vibrating Sieve.

INTRODUCTION

Grinding is a reduction of materials into particulate sizes either in dry medium as coarse, fine, smooth or wet medium as in paste form [3].Various types of grinders exist and have different names regarding to the material, medium or purpose (operation) they are used for such as multi purpose grinders, stud grinder, stone crushers, pulverizers etc.[1]. This work is done to evaluate the performance of a stud grinder using particle discretization with sieves in a dry medium using roasted guinea corn . The machine uses studs in a rotating disc by impact method among the studs and the wall of the drum[3]. The impact or momentum of the particle is a function of factors-mass of a grain of guinea corn, mass of the impelling studs, the rotating speed. and the hardness of the wall of the drum. This factors with a continuous impact or collisions of the grains with the studs and the wall of the drum result to surface deformation that causes breakage or shearing of the grains to smaller particles. Hence, grinding is achieved. The particle separation is archieved using a vertical throw electromagnetive sieving machine under certain frequency of vibration[4].

PROBLEM STATEMENT

Grading and packaging in food, cottage and pharmaceutical industries required particle sizes discretization ,such as coarse, smooth and fine particle as the case may be. The particles size generated depends on the grinding medium whether wet or dry, moisture content of the material, and the choice of grinder or mill used[1]. It therefore become necessary to validate grinding efficiency of a stud grinder for its preference and choice for high energy and time saving dry medium of bone dried or roasted materials grinding.

SCOPE

This work is limited to analyzing the performance of a stud grinder grinding in a dry medium using particle descritization with a vertical throw electromagnetic sieving machine of samples of grinded products at five different speeds-600,900,1200,1500 and 1800 rpm respectively. The machine is powered by a variable speed 2Hp electric motor.

AIMS AND OBJECTIVES

The aims and objectives of this work are itemized as detailed

i. To evaluate the grinding efficiency of a stud grinder through particle descritization method with vertical throw electromagnetic sieving machine.
ii. To established the effect of speed on grinding or particles sizes.
iii. To establish sizes in μm that can be obtained at certain speed of the stud grinder.

SIGNIFICANCE

The essence of this work is to establish the performance of stud grinder in dry grinding by using stone dried, or roasted grains, cereals or legume, however roasted guinea corn was used to determine the grinding ability with particle discretization analysis with a vertical throw electromagnetic sieve.

APPARATUS /TOOOLS

The apparatus used in this work are listed as follows.

i. Stud grinding machine.
ii. Roasted guinea corn
iii. Electromagnetic sieve
iv. vi. Electronic weighing machine.
v. Stop watch
vi. vi .brush
vii. tacometer.

METHODOLOGY/PROCEDURE

The machine stud grinder is powered by a variable speed electric motor with power transmission via a V-belt,V-pulley system with speed ratio 1:2 between the machine and the prime mover respectively. The machine is runned to ensure the two pulleys and belt are aligned to avoid dynamic imbalance that will lead to vibration, lost of power, high heat dissipation that can lead to belt rupture. Five samples of roasted guinea corn are weighed 2Kg each. Each of these samples is tagged with the one of the speeds - 600,900,1200,1500, and 1800 rpm respectively. Before grinding, make sure the machine speed is steady or optimum and measure it with a tachometer to get the specific speed wanted. The sample will be fed in the machine but no regrinding after which you open the grinding chamber dust it of every particle to the collected to avoid mixing of other samples particles, and couple it back before the next operation on the next sample. This procedure should be repeated for all samples remaining. After the grinding operation, each samples with its speed tag is taking to a vertical throw electromagnetic sieve with seven sieves - 10,15,20,25,30,35, and 40 μm with a base collector which are weighed with an electronic digital weighing machine. The sieving operation is timed 3 minutes with a stop watch, at which each sample found remaining in each sieves with the collector is weighed, and recorded respectively. This process is repeated in the remaining samples.

RESULTS

The results for the particle descritization using a vertical throw electromagnetic sieve to determine the performance evaluation of the grinding efficiency of a stud grinding machine are in the tables 1 to 5.

Table 1:Grinding Speed :600rpm,Grinded Sample Guinea Corn :1.98kg,Sieving Time 3minutes

MESH NUMBER[S/N]	MESH WEIGHT(kg)	MESH WEIGHT +GUINEA CORN POWDER(Kg)	WEIGHT GUINEA CORN POWDER(Kg)	PARTICLE SIZE (μm)
1	0.350	0.778	0.428	10
2	0.380	0.806	0.426	15
3	0.400	0.792	0.392	20
4	0.350	0.576	0.226	25
5	0.380	0.538	0.158	30
6	0.450	0.557	0.107	35
7	0.480	0.573	0.093	40
COLLECTOR	0.620	0.680	0.060	>40

Table 2 Grinding Speed :900rpm,Grinded Sample Guinea Corn :1.90kg,Sieving Time 3minutes

MESH NUMBER [S/N]	MESH WEIGHT(kg)	MESH WEIGHT +GUINEA CORN POWDER(Kg)	WEIGHT GUINEA CORN POWDER(Kg)	PARTICLE SIZE (μm)
1	0.350	0.620	0.270	10
2	0.380	0.681	0.301	15
3	0.400	0.728	0.328	20
4	0.350	0.627	0.277	25
5	0.380	0.639	0.259	30
6	0.450	0.665	0.215	35
7	0.480	0.624	0.144	40
COLLECTOR	0.620	0.734	0.114	>40

Table 3 Grinding Speed :1200rpm,Grinded Sample Guinea Corn :1.92kg,Sieving Time 3minutes

MESH NUMBER [S/N]	MESH WEIGHT(kg)	MESH WEIGHT +GUINEA CORN POWDER(Kg)	WEIGHT GUINEA CORN POWDER(Kg)	PARTICLE SIZE (μm)
1	0.350	0.420	0.070	10
2	0.380	0.552	0.172	15
3	0.400	0.552	0.198	20
4	0.350	0.551	0.201	25
5	0.380	0.635	0.258	30
6	0.450	0.755	0.305	35
7	0.480	0.800	0.320	40
COLLECTOR	0.620	1.016	0.396	>40

Table 4: Grinding Speed :1500rpm,Grinded Sample Guinea Corn :1.86kg,Sieving Time 3minutes

MESH NUMBER [S/N]	MESH WEIGHT(kg	MESH WEIGHT +GUINEA CORN POWDER(Kg	WEIGHT GUINEA CORN POWDER(Kg)	PARTICLE SIZE (μm)
1	0.350	0.377	0.027	10
2	0.380	0.455	0.075	15
3	0.400	0.565	0.165	20
4	0.350	0.518	0.168	25
5	0.380	0.560	0.180	30
6	0.450	0.826	0.376	35
7	0.480	0.881	0.401	40
COLLECTOR	0.620	1.087	0.467	>40

Table5:Grinding Speed :1800rpm,Grinded Sample Guinea Corn:1.80kg,Sieving Time 3minutes

MESH NUMBER [S/N]	MESH WEIGHT(kg	MESH WEIGHT +GUINEA CORN POWDER(Kg	WEIGHT GUINEA CORN POWDER(Kg)	PARTICLE SIZE (μm)
1	0.350	0.355	0.005	10
2	0.380	0.398	0.018	15
3	0.400	0.492	0.092	20
4	0.350	0.549	0.099	25
5	0.380	0.596	0.216	30
6	0.450	0.805	0.355	35
7	0.480	0.949	0.469	40
COLLECTOR	0.62	1.166	0.546	>40

Table 6 Effect Of Speed On Machine Performance

S/N	SPEED RPM	MASS OF PARTICLE AT 40micro meter (Kg)
1	600	0.093
2	900	0.144
3	1200	0.32
4	1500	0.401
5	1800	0.469

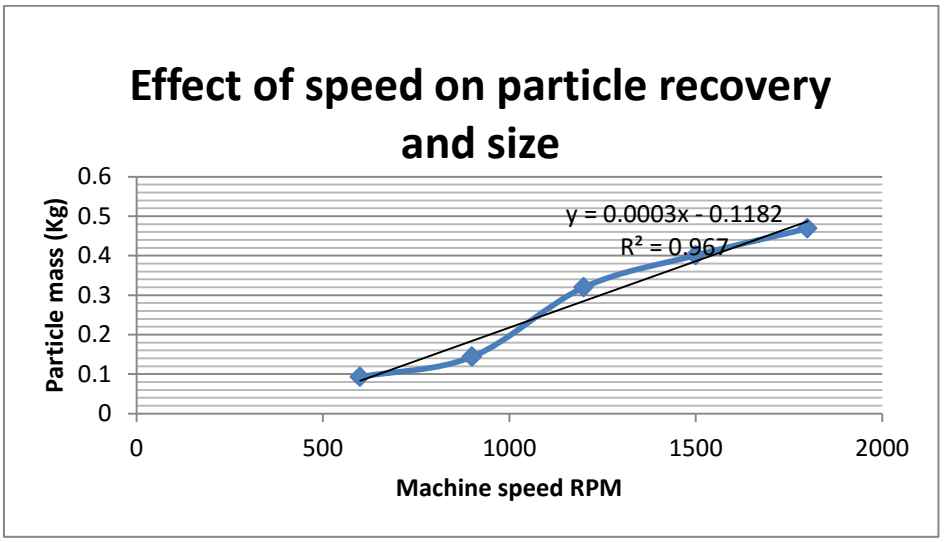

Fig A Graph Of Particle Mass Collected At 40μm (Kg) Against Machine Speed RPM

DISCUSSION

From the results obtained in table 1 to 5 it is seen that weights obtained tend to increase down the set of meshes. This suggests an indication that the particle sizes decrease as the speed increases ,and more particle size greater than 40 µm resulted at the collector as the speed increases which indicates that higher speeds favour the grinding ability and efficiency of the stud grinder. Table 6 and figure1 show this effect that the grinding efficiency is a function of the speed . the higher the speed the higher the momentum and impact.

CONCLUSSION

The grinding operations for the five samples were conducted under strict adherence to the procedures to obtained dependable results. Thus, it is concluded that stud grinder grinding efficiency is a function of its speed, and this is favoured under higher speeds except under undesirable speeds that will lead to dynamic imbalance ,vibration and excessive heat generation on the belt under high tension and burning of the belt.

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