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MANUFACTURE AND EVALUATION OF MILLS PRODUCTS GRADING UNIT WORKING BY VIBRATION THEORIES

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ABSTRACT

The aim of this study is to manufacture and evaluate a simple vibrator separator for separating crushed corn products to increase the separation efficiency of crush corn to be used in poultry feed by 3 crushing degrees (first - growing - final) feed depends on poultry age. The vibration screen was studied under the following parameters: four levels of vibration wave length (1.5, 3, 4.5 and 6 cm), three levels of hammer mill screens hole diameter (4, 6 and 8mm), three levels of screen holder angle (20^o, 30^o and 40^o) and two levels of springs of bearings (2 and 4). The performance was evaluated in terms of production rate, the specific mechanical energy, the average separation efficiency and machine losses. The best operating parameters were: vibration wave length (4.5 cm), hammer mill screens hole diameter (6mm), screen holder angle (30^o) and springs of bearings (4) to obtain a suitable performance for machine which were: production rate (0.714Mg/hr.), the specific mechanical energy (1.95kW.hr./Mg), the average separation efficiency (33.33%) and machine losses (9.31%).

Key words: Corn, sieve, energy, vibration.

INTRODUCTION

Sieve separator is one of the main working bodies of grain cleaning machine. Modern vehicles are equipped with grain cleaning sieve modules running on different functional circuits. These modules are the working tools to get aligned the size fraction of seeds. The vibrated separator is designed to separate seeds by their differences in shape and surface texture. Bosoi *et al.* (1991) found that the dimensional analysis was given well serves as a guide in arranging the various factors in dimensionless groups, helping to plan the tests. The group to desired level of centrifugal force for enough time to cause seed separation as seed characteristics are: effect of static friction angle between the seeds and the screen, seed bulk density diameter of seed, acceleration due to gravity, the angular velocity of screen, diameter of screen and material feeding rate. Pierce (1995) reported that the rotary-type cleaner probably is most common for on-farm application. Rotary grain cleaners separate grain into size fractions by moving it through a trammel (revolving cylindrical screen with axis slightly inclined). Harles *et al.* (1999) tested six rotary grain cleaner models for efficiency of removal of fine material from dry corn at various flow rates. Cleaners were equipped with soldered-wire screens having square openings averaging 5.3 mm (0.22 in.) on a side. Removal efficiency decreased (five models) or was constant (one model) with flow rate. All cleaners were progressively less efficient as the size of fine material was increased. Sullivan *et al.* (2001) said that particles in dry bulk materials are found in a variety of shapes, sizes, surfaces, densities, and moisture content. Each condition must be taken into account when attempting to predict screen performance, through its effect on capacity in terms of weight passing a given screen opening per unit area. Amin *et al.* (2002) developed and evaluated a simple grading machine (reciprocating type) for grading the spherical crops as a dual-purpose machine to suit for

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grading the cylindroids crops such as cucumber and squash crops. Their results showed that the machine is quite successful for grading the previous crops. Their best results obtained at speed roller seizer of 0.15 m/sec. and slope angle of zero. Amin (2003) stated that four different crops with different percentage of spheroid (radish about 100%, lentils 78%, haricot beans 76% and kidney beans 53%) were used to assess the grading efficiency of vibrating and rotary sieve machines. He found that the cell shape, speed, position of cells sieves inclination, sieves speeds and sieving time were the main factors that effect on separation and grading efficiencies of the grading machine. El-Nakib and Abdel-Galil (2008) developed and evaluated rotating screen separator for grading and cleaning fenugreek seeds. A horizontal cylindrical screen unit was designed, and used to grade fenugreek seeds and to separate trashy materials from it. Fouda (2009) found that increasing sieve angle from 10 to 15 degrees, measured for various feeding rates of 0.5, 0.6, 0.7, 0.8 and 0.9 kg/min, increased separator productivity by 16.02, 16.29, 37.01, 38.34 and 29.78% at constant paddy moisture content of 14% any further increase in sieve angle from 15 up to 20 degrees, separator productivity was decreased by 3.84, 7.07, 24.53, 24.47 and 17.20% under the same previous conditions. Ujam and Enebe (2013) designed and constructed an electromagnetic sieving machine which transforms electromagnetic energy to mechanical energy to grading the particle sizes of powders and granular distribution of particle sizes of a local agricultural product.

Ramana *et al.* (2014) used vibrating feeders for a wide variety of applications such as metering and transferring of material from bins, hoppers, silos and storage piles to crusher, screens and belt conveyors and protecting other equipment from impact.

The aim of this study is to manufacture and evaluate a simple vibrator separator for separating crushed corn products to increase the separation efficiency of crushed corn to be used in poultry feed by 3 crushing degrees (first - growing - final) feed depends on poultry age and study some of mechanical factors.

MATERIALS AND METHODS

The main experiments were carried out during (2013 and 2014) at a private workshop in Zagazig, City Sharkia Governorate to fabricate and evaluate a rotary separator working by vibration theory to separate the milling products into different particle sizes suits for pelleting process.

Materials

Milling Raw Material

Corn seeds were used in this experimental, the corn seeds were milled using a hammer mill machine with screens of 4, 6 and 8 mm to produce different particle sizes of milled corn to be used by high percentage in poultry feed formula by pelleting process with about 40% or feed as mash for poultry eggs production farms .

Specification of the manufactured vibrator screener

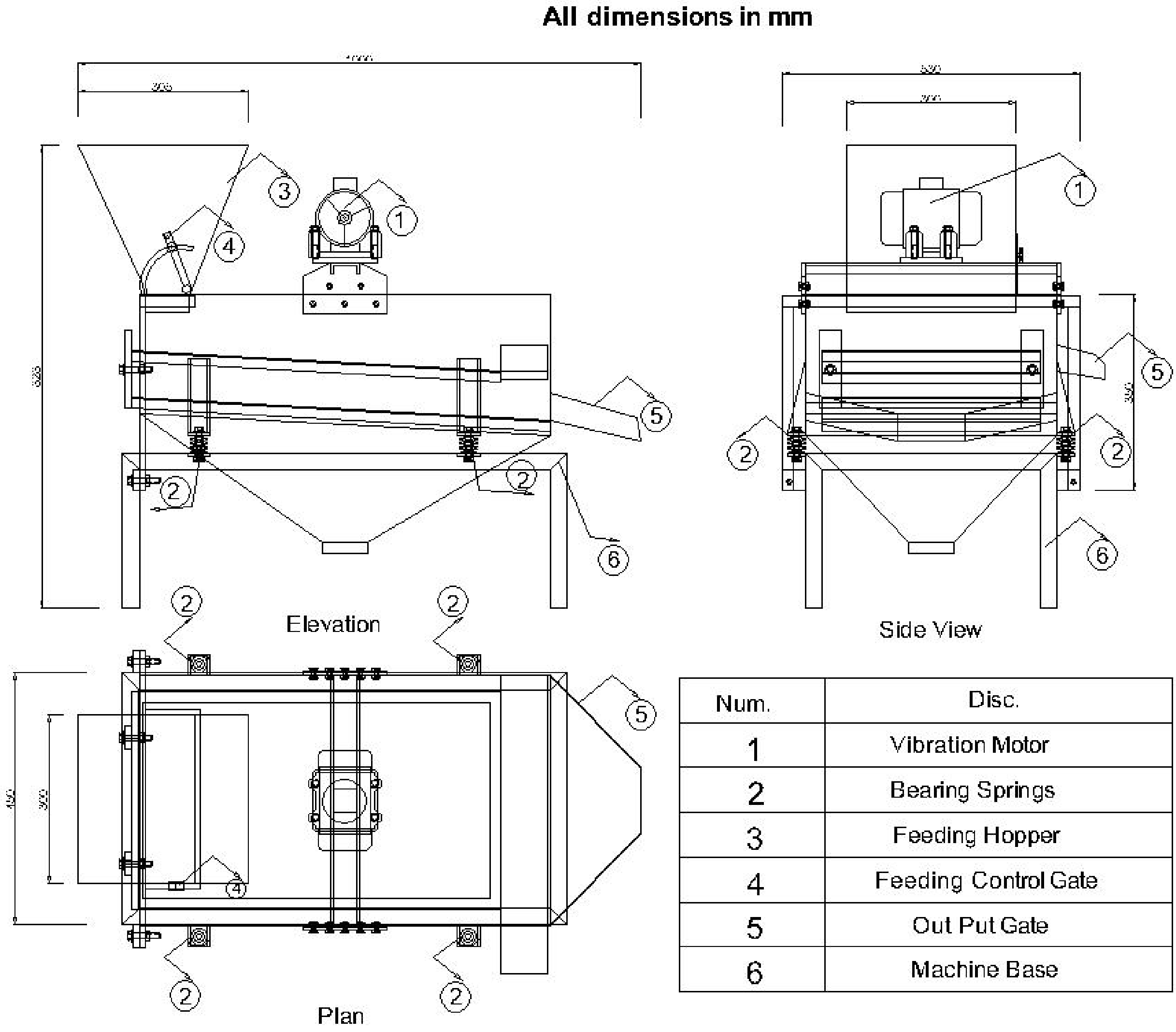
The manufactured machine used in this study consists of the main following parts: (machine base, screens holder, motor base, feeding mechanism, bearing springs, vibrator motor and output gats). The machine has dimensions of 1000 mm length, 530 mm width and 828 mm highest, the screen holder based on the machine frame by 4 bearing springs(Fig. 1).

Machine base

machine base was made from iron bars has L shape 30 × 30 mm, the machine frame has dimension of 795 × 450 mm. The frame was based on 4 legs with length of 276mm made from iron bars L shaped 30 × 30 mm, there are 4 springs with length of 40 mm to connect the screen holder by machine base, the total width of frame was 510 mm.

Screen holder

The separation screen holder is the part that hold the screens in the separation machine . It has slopes from 3 directions to move the corn mill to output gates. The separation screen has 3 output gates, one is in elevation side for rough corn mill, second gate is in side view for medium rough corn mill and the third gate is at bottom side for fine corn mill. The dimensions of the screen holder were 735×520×462 mm., there are 3 slopes in screen holder 12% slope to the elevation gate, 18% slope to the side view gate and conical slope to the bottom gate.



Num.	Disc.
1	Vibration Motor
2	Bearing Springs
3	Feeding Hopper
4	Feeding Control Gate
5	Out Put Gate
6	Machine Base

Fig. 1. Elevation, plan and side view for the separation machine

Screens

Two screens to control the product separation size, the separation machine has 2 screens which has two hole diameters of 3 and 5mm and thickness of 1.5 mm. the dimension of the screens were 725 × 380 mm, the screen frame has dimension of 735 × 380 × 20 mm.

Feeding mechanism

Feeding unit consists of feeding hopper and feeder control gate.

Feeding hopper

The feeding hopper bin has conical shape with dimensions of 300 × 305 mm from the upper and 300 × 100 in bottom. The feeding hopper highest was 300mm

Feeding control gate

The feeding hopper has feeding control gate including gate plate which has dimensions of 90 × 290 × 2 mm., connected with gate arm has scale by arm support on the hopper, the mechanism of control gate that controlling the feeding rate by controlling the plate angle on the horizontal axis.

Feeder base

The feeding hopper was connected with screen holder by feeder base made from square bar 50 × 50 mm., the feeder base has U shape with dimensions of 530 mm. width connected with feeding hopper and 349 mm., legs connected with screens holder by 4 bolts.

Vibration motor

Vibration motor is considered one of the very important part in vibrator screen because it exposed to a very high stress by vibration motor, it consists of base bar with dimensions of 462 × 80 × 100 mm., it has pallet in middle to set the vibrator motor with dimensions of 110 × 116 × 60 mm., the pallet has 4 holes each of 27 mm., in diameter to install the vibrator motor, the base bar fixed from both sides by 2 pallets with dimensions of 150 × 92 × 8 mm., each pallet has 5 holes each of 8mm diameter to connect the motor base by the screen holder to transfer the vibration waves to screens.

Power transmission system

The power transmission system of vibration screen depends entirely on the vibration motor Its specifications are shown in Table 1.

The vibrator motor principals have 4 centrifugal cams, 2 at each side working by synchrony to control the vibration wave length. The centrifugal force is infinitely variable. Under consideration of the admissible power absorption the vibrator can be run continuously. The vibration wave work in 3 axis (X, Y and Z) and the waves move the screen holder including the screens and feeding system that all support on the 4 spring bearings.

Methods

The experiments were carried out to optimize some operating and engineering parameters affecting the performance and efficiency of separation machine.

Experimental Condition

The vibration screen was evaluated under the following parameters:

* Four levels of vibration wave length (1.5, 3, 4.5 and 6 cm). To adjust the vibration wave changing the angle between two cams in both sides of vibration .

* Three holder angles (20^o, 30^o and 40^o).

* Three profiles milling product diameters (4, 6 and 8mm).

* Two levels of screen number of springs of bearings (2 and 4) by increasing the hight of back springs.

Measuring Instruments

Electrical balance

An electrical balance scale (OHAUS- USA) was used for massing the full fat corn samples. The maximum mass of the electrical balance was 2610 g and it's accuracy was 0.1 g.

Tachometer

A digital photo/contact tachometer (LCD) was used to measure rotation speed of electric motors shaft, feeding shaft and also rotation speed of the electric motor wide measuring rang from 0.5 to 100.000 rpm with accuracy of ± 0.05 / digital.

Stop watch

The net consumed time for each treatment was measured by using digital stopwatch (Casio JHS – 20 accuracy 1/100 second).

Clamp meter and voltmeter

A clamp meter and voltmeter were used for measuring current intensity and voltage, respectively. The specification of the used clamp meter and voltmeter are as following : made in Japan, type : super clamp meter 700k 600v~Ac 50 Hz Power

Calculations

Machine productivity

The vibration screen productivity was calculated from the following relation:

$$EP = \frac{Wp}{T}$$

Where:

EP: the vibration screen productivity, (Mg/hr.), Wp: corn mass, (Mg) and T: consumed time, (hr.).

Specific mechanical energy (SME)

The following formula was used to estimate the power consumed

$$Po = \sqrt{3}\cos\theta \times I \times V \times \frac{1}{1000}$$

Where:

Po : required power, (kW), I : current intensity, (A) ,V : voltage, (380V) and cos θ = 0.7.

Table 1. The vibrator motor specification

Model	Synchrony speed	Centrifugal force	Working moment	Changing centrifugal force	Slandered voltage 50PCS	Normal current	Power
Unit	**Min $^{-1}$**	**daN**	**Cm kg**	**Inf. vari.**	**V**	**A**	**W**
HV 85/4-300	1500	3700	300	2	3 ~ 230/400	6,4/3,7	2000

The specific mechanical energy was obtained using the following equation:

$$ER = \frac{P}{EP}$$

Where:

ER : energy requirements, (kW.hr./Mg),

P: required power, (kW) and

EP : machine productivity, (Mg/hr.).

Separation efficiency

$$\text{Separationefficiency} \quad (\%) = \frac{Oa}{Ob} \times 100$$

Where :

Ob : Total amount of production rate , (Mg) and
Oa : The amount of under size, (Mg).

Machine Losses (%)

$$\text{Losess} \quad (\%) = \frac{ML}{MP} \times 100$$

Where :

MP : Total amount of production rate , (Mg) and
ML : The amount of product out of screen (Mg).

RESULTS AND DISCUSSION

Influence of Some Operational Factors on Production Rate

Data in Table 2 clarify that increasing vibration wave length was accompanied with an increase in the production rate under angles of 20, 30 and 40^o. It was noticed that, the increase of screen holder angle caused an increase in the production rate. From these results the highest value of production rate was at screen holder angle of 40 deg . The production rate increased by increasing hammer mill screens hole diameters of 4 and 6. From these results, the highest value of production rate was at hammer mill screens hole diameters of 8mm. Increase the number of springs from 2 to 4 was forward with an increase in the production rate.

Influence of Some Operational Factors on Energy Consumed

Mechanical energy is one of the most important measure for any machine efficiency, vibration waves were studied and data was plotted in Fig. 2 at hammer mill screens hole diameter 4 mm and number of springs of bearings 2. It was cleared that the increase of vibration wave caused an increase in specific energy. The same trend obtained from Figs. 3, 4, 5, 6 and 7. Energy consumed and its relation with screen holder angles of 20 to 30 and 40°C under different vibration wave using hammer mill screens hole diameter 4,6 and 8mm and number of bearings 2 was investigated and the results were shown in Figs. 2, 4 and 6 which showed that the increase of screen holder angles followed with a reduction in the energy consumed. The same trend was recorded in the case of using number of bearings 4, it showed from Figs. 3, 5 and 7. Under experimented conditions included vibration waves (1.5 cm), screen holder angle (40^o) and different number of springs the effect of different hammer mill screens hole diameter of 4,6 and 8 mm on the specific energy consumed was studied and the obtained data indicated that the increase of hammer mill screens hole diameter caused an decrease in the specific energy with 4 and 6 mm and increase with 8mm and decrease in 4 and 6 mm and increase with 8mm in the case of using number of springs 2 and 4, respectively.

Table 2. Influence of some operational factors on production rate (Mg/hr.)

Vibration wave length (cm)	**Number of springs**	**Screen working angle (DEG)**								
		20			**30**			**40**		
		4mm	**6mm**	**8mm**	**4mm**	**6mm**	**8mm**	**4mm**	**6mm**	**8mm**
1.5	2	0.457	0.510	0.572	0.596	0.661	0.730	0.645	0.715	0.777
	4	0.460	0.513	0.576	0.600	0.665	0.734	0.649	0.719	0.781
3	2	0.470	0.524	0.588	0.613	0.679	0.750	0.663	0.735	0.798
	4	0.472	0.534	0.591	0.616	0.683	0.754	0.666	0.738	0.802
4.5	2	0.492	0.552	0.616	0.641	0.711	0.785	0.694	0.769	0.835
	4	0.494	0.577	0.618	0.644	0.714	0.788	0.697	0.772	0.839
6	2	0.503	0.585	0.630	0.656	0.728	0.803	0.710	0.787	0.855
	4	0.504	0.593	0.631	0.658	0.730	0.805	0.712	0.789	0.857

Table 3. Influence of some operational factors on separation efficiency (%)

Vibration wave length (cm)	**Number of springs**	**Screen Working angle(DEG)**								
		20			**30**			**40**		
		4mm	**6mm**	**8mm**	**4mm**	**6mm**	**8mm**	**4mm**	**6mm**	**8mm**
1.5	**2**	457.55	510.81	572.65	596.76	661.77	730.43	645.73	715.66	777.05
	4	460.25	513.83	576.04	600.28	665.68	734.74	649.54	719.89	781.64
3	**2**	470.15	524.87	588.42	613.19	679.98	750.53	663.50	735.36	798.44
	4	472.45	527.44	591.30	616.19	683.31	754.21	666.75	738.96	802.35
4.5	**2**	492.22	549.51	616.04	641.97	711.90	785.76	694.65	769.88	835.92
	4	494.06	551.57	618.35	644.38	714.58	788.72	697.26	772.77	839.06
6	**2**	503.52	562.12	630.18	656.71	728.25	803.80	710.60	787.56	855.11
	4	504.81	563.57	631.80	658.40	730.12	805.87	712.42	789.58	857.31

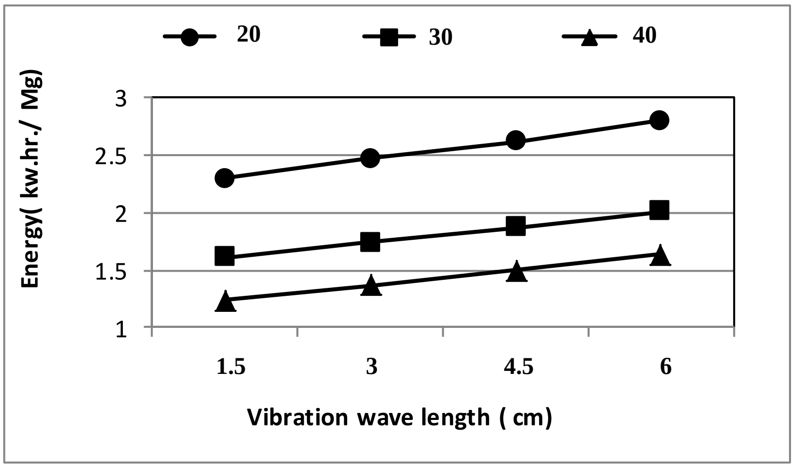


Fig. 2. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 4mm and number of springs of bearings 2

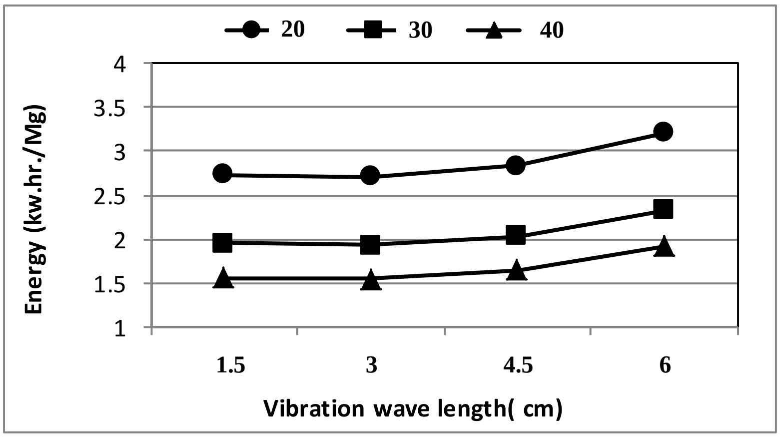


Fig. 3. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 4mm and number of springs of bearings 4

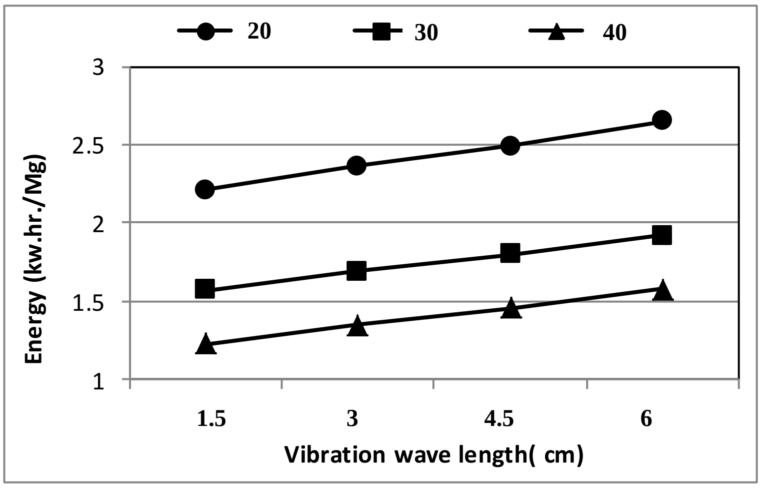


Fig. 4. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 6mm and number of springs of bearings 2

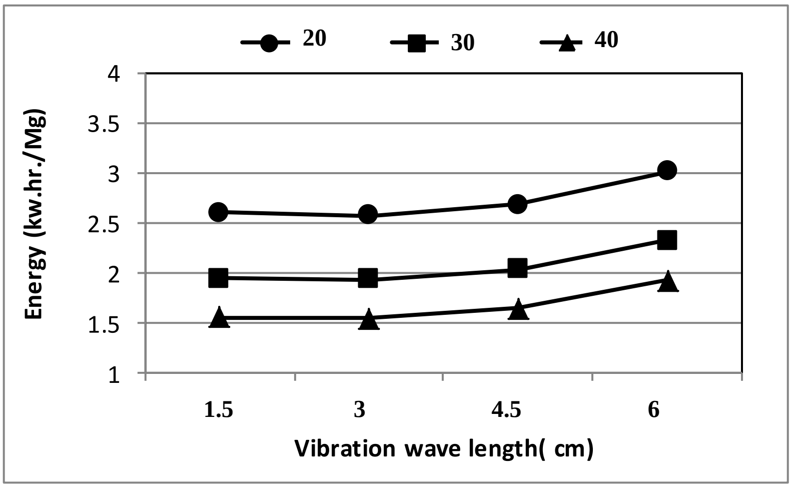


Fig. 5. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 6mm and number of springs of bearings 4

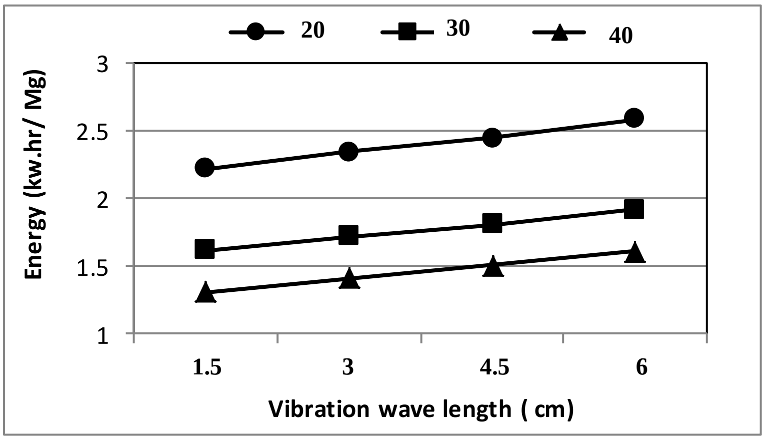


Fig. 6. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 8mm and number of springs of bearings 2

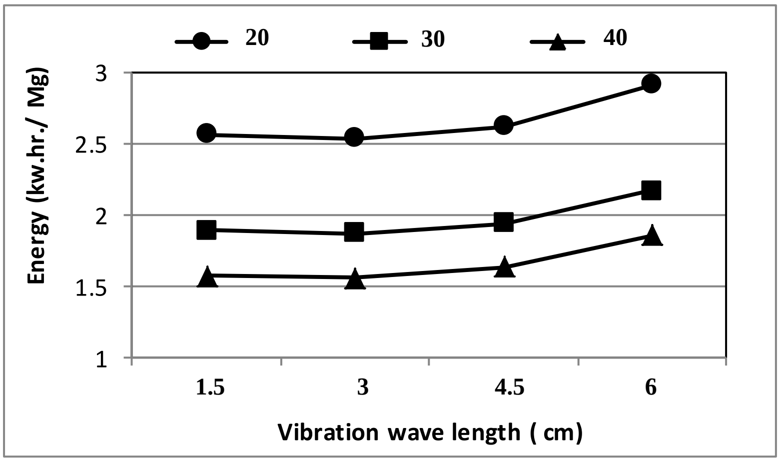


Fig. 7. Influence of vibration wave length on energy requirements at hammer mill screens hole diameter 8mm and number of springs of bearings 4

Influence of Some Operational Factors on Separation Efficiency

The effect of vibration waves on separation efficiency under screen holder angles of (20, 30 and 40°) using hammer mill screens hole diameter of (4,6 and 8 mm) and number of springs (2 and 4), was studied and the results were shown in Table 4. It was noticed that the values were differed according to the particle size. For vibration waves of (1.5, 3, 4.5 and 6 cm), these values were (62.98, 64.35, 64.70 and 65.61) for particle size up to 5mm,(25.55, 26.45, 26.92 and 27.65) for particle size up to 3mm and (11.48, 9.20, 8.38 and 6.74) for particle size less than 3mm. From these results, the vibration wave which was 6 cm , made the highest separation efficiency for particle size up to 5mm and up to 3mm, while the highest separation efficiency was obtained with the vibration wave 1.5 cm for particle size less than 3mm. It was noticed that for screen holder angles of (20, 30 and 40°), these values were (39.38, 45.93 and 65.61) for particle size up to 5 mm., (34.17, 38.37 and 27.65) for particle size up to 3mm and (26.00, 15.70 and 6.74) for particle size less than 3mm. From these results, the screen holder angle 40° made the highest separation efficiency for particle size up to 5mm and the screen holder angle 30° made the highest separation efficiency for particle size up to 3mm, while the highest separation efficiency was obtained with the screen holder angle 20° for particle size less than 3mm. For hammer mill screens hole diameter of (4, 6 and 8mm),these values were (32.10, 33.46 and 65.61) for particle size up to 5 mm., (29.00, 41.16 and 27.65) for particle size up to 3mm and (38.90, 25.38 and 6.74) for particle size less than 3 mm. From these results, hammer mill screens hole diameter of 8 mm made the highest separation efficiency for particle size up to 5mm and hammer mill screens hole diameter of 6 mm made the highest separation efficiency for particle size up to 3mm, while the highest separation efficiency was obtained with hammer mill screens hole diameter of 4 mm for particle size less than 3mm. The effect of number of springs on separation efficiency pelted in Table 4. It was noticed that the values were differed according to the particle size. For number of springs of (2 and 4),these values were (33.19 and 33.46) for particle size up to 5 mm., (40.77 and 41.16) for particle size up to 3mm and (26.04 and 25.38) for particle size less than 3 mm. From these results, number of springs of 4, made the highest separation efficiency for particle size up to 5mm and up to 3mm, while the highest separation efficiency was attained with number of springs of 2 for particle size for particle size less than 3 mm.

Influence of Some Operational Factors on Machine Losses

Fig. 8 show the values of machine losses under vibration waves of (1.5, 3, 4.5 and 6 cm) at screen holder angle (20°), and hammer mill screens hole diameters of (4, 6 and 8 mm) using number of springs of bearings (2). It is noticed that the increase of vibration waves caused an increase in machine losses. The same trend was accrued in case of using number of springs of bearings (4) and using screen holder angle (30 and 40°). Figs. 8, 10 and 12, show the values of machine losses under screen holder angles of (20, 30 and 40°) at vibration waves (1.5, 3, 4.5 and 6 cm), hammer mill screens hole diameters of (4 mm) using number of springs of bearings (2). It is noticed that the increase of screen holder angles caused an increase in machine losses. The same trend was accrued in case of using hammer mill screens hole diameters of (6 and 8 mm)**.** Figure (8), show the values of machine losses under hammer mill screens hole diameters of (4, 6 and 8 mm) at vibration waves of (1.5, 3, 4.5 and 6 cm), screen holder angle (20°), and using number of springs of bearings (2). It is noticed that the increase of hammer mill screens hole diameters caused an increase in machine losses. The same trend was accrued in case of using screen holder angle (30 and 40°). Figs. 8 and 9, show the values of machine losses under number of springs of bearings (2 and 4) at vibration waves (1.5, 3, 4.5 and 6 cm) and screen holder angle of (20°) using hammer mill screens hole diameter of (8 mm.). It is noticed that the increase of number of springs of bearings caused an increase in machine losses. The same trend was accrued in case of using screen holder angle (30 and 40°). From the above results, the lowest value of the machine losses (zero %) reduced from vibration wave (1.5, 3 and 4.5cm), hammer mill screens hole diameters (4 mm.), screen holder angle (20°) and number of springs of bearings (2 and 4). However, the biggest value of the machine losses (18.09%) reduced from vibration wave (1.5 cm), hammer mill screens hole diameters (8mm), screen holder angle (40°) and number of springs of bearings (4).

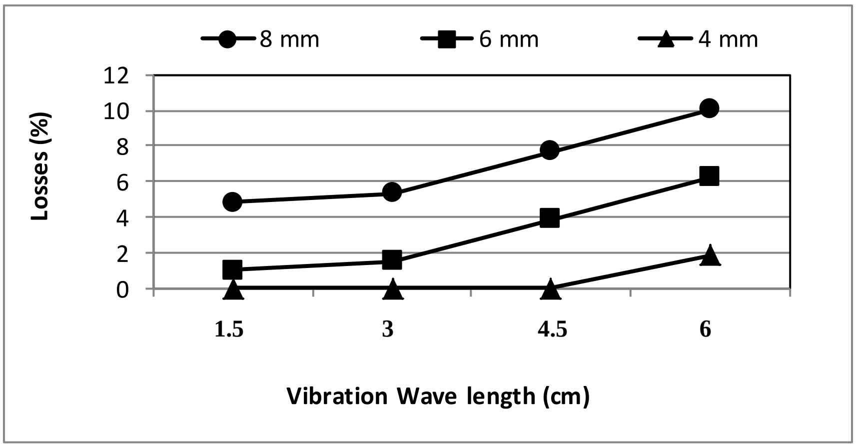


Fig. 8. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 20° and number of springs of bearings 2

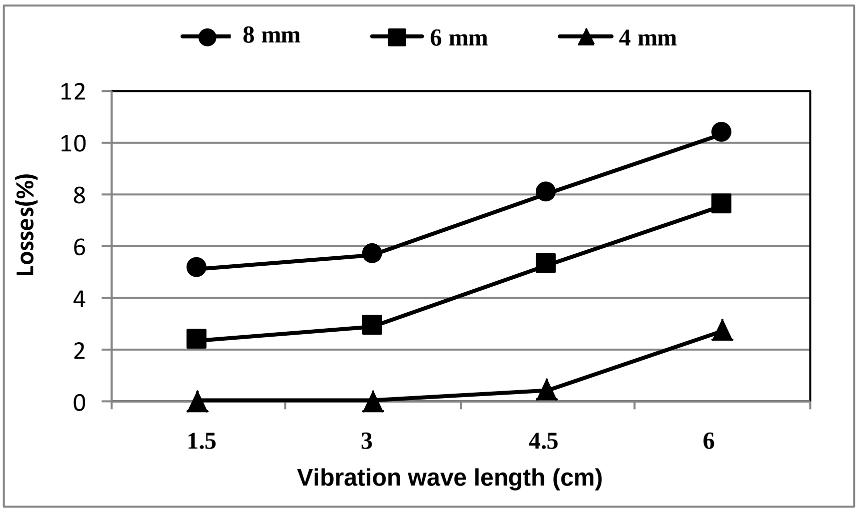


Fig. 9. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 20° and number of springs of bearings 4

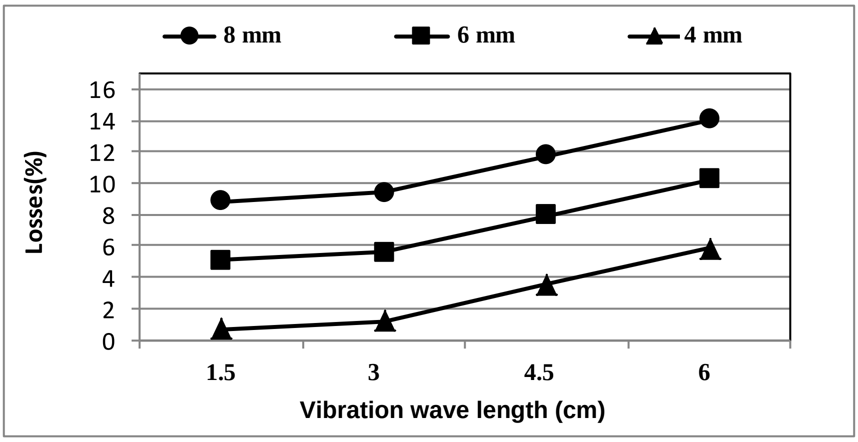


Fig. 10. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 30° and number of springs of bearings 2

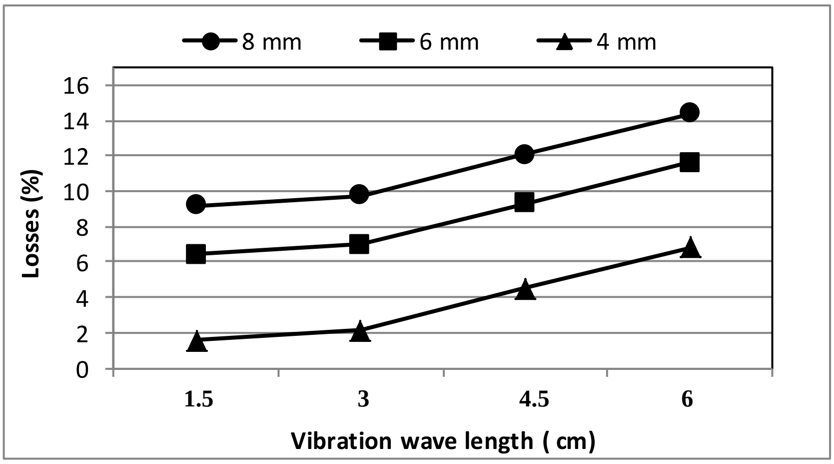


Fig. 11. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 30° and number of springs of bearings 4

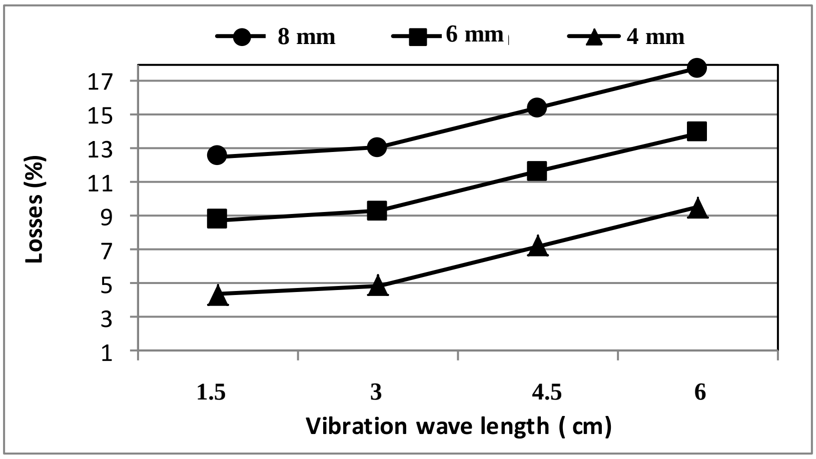


Fig. 12. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 40° and number of springs of bearings 2

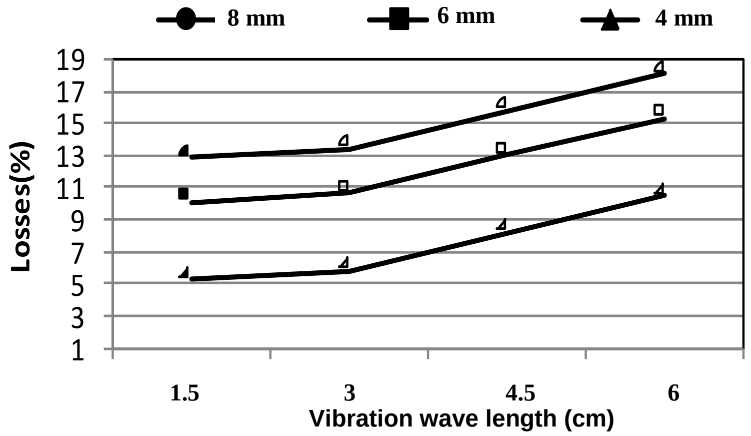


Fig. 13. Influence of vibration wave length and hammer mill screens hole diameters on machine losses at screen holder angle 40° and number of springs of bearings 4

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تصنيع وتقييم وحدة لتدريج نواتج الطحن تعمل بنظريات الاهتزاز

لمياء سيد عبد المنعم – محمود عبدالرحمن الشاذلي – أسامة أحمد خليل قدور – منى محمود عبدالعزيزحسن

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استهدفت الدراسة تصنيع وتقييم غربال هزاز لفصل منتجات الطحن مختلفة الأحجام لتناسب عملية إنتاج المصبعات، وقد تم تصنيع الآلة في ورشة عمل خاصة في الزقازيق، محافظة الشرقية، حيث تكونت الآلة من الأجزاء الرئيسية التالية: قاعدة الماكينة، و حامل الغرابيل، قاعدة المحرك، نظام تغذية، واليايات (الزمبرك)، محرك هزاز وبوابات لخروج نواتج الفصل المختلفة، وكانت أبعاد الماكينة (٥٢٨ × ٥٣٠ × ١٠٠٠) ملليمتر، حامل الغرابيل مرتكز على هيكل الماكينة عن طريق أربع يايات (زمبركات)، وقد تم اختبار الآلة وإجراء التجارب عليها خلال عامي (٢٠١٣ و ٢٠١٤) وذلك لتقييم ادائها من خلال مجموعة من عوامل التشغيل شملت:أربعة أطوال للاهتزازة (١.٥ و ٣ و ٤.٥ و ٦ سم)، ثلاثة اقطار لفتحات الغرابيل (٤ و ٦ و ٨ مليمتر) ، ثلاثة زاويا لحامل الغرابيل (٢٠ ، ٣٠ و٤٠ درجة) ومستويان من أعداد اليايات (٢ و٤)، وتم تقييم أداء الآلة من خلال قياس كل من: الإنتاجية (ميجا جرام/ساعة)، استهلاك الطاقة (كليووات.ساعة/ ميجاجرام)، كفاءة الفصل (%)، نسبة الفواقد (%)، وقد شملت الدراسة على العديد من النتائج يمكن تلخيصها على النحو التالى: إنتاجية الآلة من خلال تأثير عوامل التشغيل المذكورة سالفا على الانتاجية بينت النتائج التى تم الحصول عليها على وجه العموم زيادة الانتاجية بزيادة كل من طول الاهتزازة و زاوية حامل الغرابيل وقطر الغرابيل مع استخدام زوجين من اليايات، وكانت أقصى إنتاجية ٠.٨٥٧ ميجاجرام/ساعة و ذلك عند استخدام طول اهتزازة ٦ سم ، زاوية حامل الغرابيل ٤٠ درجة ، قطر فتحات الغرابيل ٨ ملليمتر مع استخدام زوجين من اليايات، الطاقة النوعية المستهلكة سجلت زيادة فى القيم الخاصة بها بزيادة كلا من طول الاهتزازة و قطر فتحات الغرابيل مع استخدام زوجين من اليايات و نقص زاوية حامل الغرابيل، وكان اقل استهلاك للطاقة ١.٢٠ كيلووات.ساعة/ميجاجرام وذلك عند استخدام طول اهتزازة ١.٥ سم، زاوية حامل الغرابيل٤٠ درجة ،قطر فتحات الغرابيل ٦ ملليمتر مع استخدام زوج من اليايات، كفاءة الفصل النتائج المتحصل عليها بينت ان كفاءة الفصل للحبيبات اختلف تأثير عوامل التشغيل عليها طبقا لحجم الحبيبات، كانت أعلى كفاءة فصل للحبيبات التى قطرها اكبر من ٥ ملليمتر ٦٥.٦١ % و ذلك عند استخدام طول اهتزازة ٦ سم، زاوية حامل الغرابيل ٤٠ درجة، قطر فتحات الغرابيل ٨ ملليمتر مع استخدام زوجين من اليايات، وكانت أعلى كفاءة فصل للحبيبات التى قطرها اكبر من ٣ ملليمتر ٤٦.١٠ % وذلك عند استخدام طول اهتزازة ٦ سم، زاوية حامل الغرابيل ٣٠ درجة، قطر فتحات الغرابيل ٦ ملليمتر مع استخدام زوجين من اليايات، وكانت أعلى كفاءة فصل للحبيبات التى قطرها اقل من ٣ ملليمتر ٧٢.٢٧ % وذلك عند استخدام طول اهتزازة ١.٥ سم، زاوية حامل الغرابيل ٢٠ درجة ،قطر فتحات الغرابيل ٤ ملليمتر مع استخدام زوج من اليايات، نسبة الفواقد تبين من الدراسة ان زيادة كل من طول الاهتزازة وزاوية حامل الغرابيل و قطر فتحات الغرابيل عن حدود معينة نتج عنه زيادة فى نسبة الفاقد، فكانت اقل نسبة فواقد صفر(%) وذلك عند استخدام طول اهتزازة ١.٥ ،٣ و ٤.٥ سم، زاوية حامل الغرابيل ٢٠ درجة، قطر فتحات الغرابيل ٤ ملليمتر مع استخدام ٢ و ٤ من اليايات، يفضل تشغيل الآلة تحت معاملات التشغيل الآتية: طول الاهتزازة ٤.٥ سم، زاوية حامل الغرابيل ٣٠ درجة، قطر فتحات الغرابيل ٦ ملليمتر مع استخدام زوجين من اليايات.

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