CLEANING WHEAT GRAIN BY USING RICE POLISHER MACHINE

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ABSTRACT

A rice polishing machine was developed and tested for cleaning wheat grain. It consists of a feeding unit, cleaning unit, power drive unit and power transmission unit. Four levels of moisture content were about [9.9, 12.4, 14.9 and 17.6 % (d.b.)]; three friction surfaces with three static coefficient of friction were [smooth = 0.35, intermediate between smooth and rough = 0.43, and rough surface= 0.51]; four levels of pressure on cleaning chamber were [1.25, 3.75, 6.25 and 8.75 kN/m^2] and three speeds of air suction flow speeds of [1.3, 2.8, and 3.4m/s.], were used. The maximum value of cleaning efficiency was 99.93% achieved at, moisture content (M1= 9. 9 %), pressure (P4 =8.75 kN/m^2), rough friction surface (F3=0.51), and suction air speed (S3 =3.4 m/s). The minimum value of grain damage was 3.5 % achieved at, moisture content (M4= 17.6 %), smooth friction surface (F1=0.35), pressure (P1=1.25 kN/m^2) and suction air speed (S3=3.4 m/s). The minimum value of losses due to polishing was 0.41 % achieved at, moisture content (M4=17.6 %), pressure (P1=1.25 kN/m^2), smooth friction surface (F1=0.35) and suction air speed (S1=1.3m/s).

INTRODUCTION

Wheat grain is considered one of the three major strategic crops (wheat, corn and rice) in the world. The total wheat area harvested in Egypt is equal to 2.420 million feddan; its yield is equal to 2, 7315 Mg/feddan; and its production is about 8.127 Tg (Ministry of Agric. 2009). Jesse *et al.,* (1968) mentioned that various types of polishers may be used to clean and brighten the surface of beans, peas, and grain. Some units agitate the products with a compound like sawdust or bran in either a wet or dry process to accomplish the cleaning. Other polishers use a revolving brush to scour the grain against a rubber or screen surface. Joseph *et al.,* (1977) invented a device for separating rough particles from smooth ones, for example, removing earth clods from beans. The device utilizes the principle that the rough particles display a higher degree of friction than do the smooth particles. Okiako *et al.,* (1991) invented a grain cleaning machine comprising a cleaning chamber including a cleaning roll for cleaning uncleaned grain with, a screw conveyor for feeding the uncleaned grain into the cleaning chamber, a discharge adjusting device disposed in a grain outflow region of the cleaning chamber, and a torque sensor for detecting an internal load of cleaning chamber. Satake *et al.,* (1991) developed a wheat flouring system comprising a polishing machine for polishing wheat grain, a humidifying machine for humidifying the grain, a conditioning machine for subjecting the grain to conditioning and milling machine for milling the grain to produce a flour. Polishing machine, the humidifying machine, the conditioning machine and milling machine are successively arranged from an upstream side to a

downstream side. There is an agitating machine for agitating the grain humidified by the humidifying machine, thereby preventing the humidified grain from sticking together into lumps of the grain. Tkac (1992) invented a system involving first removing the outer bran layers in modified rice polishers with sequential friction passage (rubbing kernels against each other), before further preprocessing by sequential abrasion passages.

The present study concentrates on cleaning wheat sequentially by friction and abrasion operations prior to milling. In this process, the bran layers, points or fuzz ends of wheat, bacteria and dirt clods are removed and discharged by a fan into a dust room without damaging grain to improve flour color, reduce storage problems from mold and insects, reduce transportation costs by removing costs to transport nonwheat material, produce a relative increase in storage capacity, improve marketability, and provide a more favorable public image.

Therefore, the objectives of the present study were as follows:

(a) To use the rice polisher machine for cleaning wheat and to evaluate the performance of the cleaning machine concerning cleaning efficiency, grain damage, percentage of polishing and operating costs.

(b) To study and recommend the best combination of operating parameters for the developed machine that maximized the cleaning efficiency, minimized damaged grain and improved color quality of flour which was much impaired by dust and fine particles of bran.

(c) Lessen the cost of wheat cleaning system with the developed machine.

MATERIALS AND METHODS

Materials:-

This study was carried out during summer season 2008-2009 on wheat variety (Sakha 93) to develop the rice polisher machine for cleaning wheat.

Machine description:-

Figures (1) illustrate the machine [rice polisher (N-110)] that was used for cleaning wheat. This type of machine is equipped by air jet system which was used for controlling outlet grain temperature and friction materials attached with the grain. The air jet comes from a blower via the main axis of the cleaning section, or in otherwords, it passes through the cleaning chamber to the outside of hexagonal screen. This modification gives a chance for air jet to cool the grain inside the cleaning chamber and blow off grain free from unwanted materials.

This machine consists of a feeding unit, cleaning unit, power drive and power transmission unit. The feeding unit consists of hopper which disposes above the inlet and spiral feed roll which transports uncleaned wheat grain delivered from above toward the cleaning unit. The cleaning unit cleans wheat by rubbing it against the perforated steel sheet as well as against itself. So it will be polished and cleaned from dust and chaff at the same operation. For proceeding all treatments, and replicates, an electric motor was used.

At the end of the shaft, there are some pulleys connected to V-belt. These pulleys and belts transmit power to the cleaning unit.

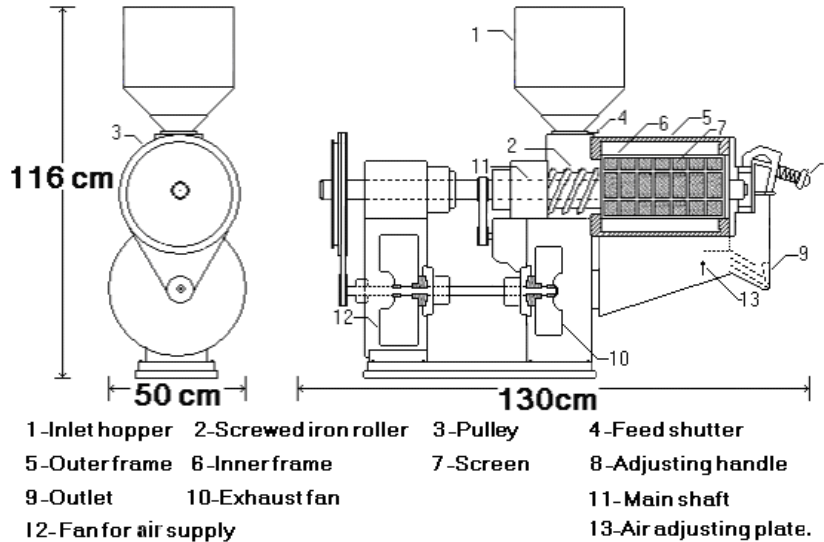**Specification of the machine:-**

The general specification of the machine is as follows:-

Overall dimensions:-

Length 130, width 50 and height 116 cm

Feeding unit mechanism:-

The feeding unit mechanism includes a hopper [49cm length, 47cm width and 65cm height] and spiral feed roll .The supply hopper is disposed above the inlet. The spiral feed roll transports uncleaned wheat grain delivered from above toward the cleaning unit.

1-Inlet hopper	2-Screwed iron roller	3-Pulley	4-Feed shutter
5-Outer frame	6-Inner frame	7-Screen	8-Adjusting handle
9-Outlet	10-Exhaust fan		11-Main shaft
12-Fan for air supply			13-Air adjusting plate.

**Figure (1): Elevation and side view of the machine.**

Cleaning unit:-

Cleaning unit Contains a friction steel roll with agitating projections from an outer periphery of the cleaning roll and extending substantially longitudinally of the latter with slots formed along the agitating projections. The hollow main rotary shaft has a number of holes formed in the peripheral wall thereof located within the cleaning roll. The rotary shaft carries a feed roll and a cleaning drum. The feed roll and cleaning drum are inter connected by coupling pins, and the cleaning drum is engaged at positions adjacent a lower end thereof circumferentially with the rotary shaft by means of keys. The friction cleaning drum is mounted on a hollow main shaft whose dimensions are shown in fig. (2) [24 cm length, 14cm width, and 0.5cm thickness] mounted with a screw feed roll (14 cm length).

In addition to a perforated cleaning screen having a polygonal cross-sectional shape such as a hexagonal shape (sec A-A) fig. (2) was assembling around the roller. It is made of 6 steel sheets [22 cm length, 6 cm width and 1mm thickness] mounted on cylindrical frame and consists of slotted screen with openings [1.5 cm length and 1 mm width] as shown in fig. (3) and (4). There is sufficient clearance of about 0.9 cm between the

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perforated cleaning screen and the friction cleaning roll to prevent the crushing of grain.

The percentage of opening area of the hexagon perforated screen was equal to 23.5 % from the total area. The hexagonal cylinder frame rotated 5 rpm during operation so that it will not be blocked. A hollow main rotary shaft extends substantially horizontally through the cleaning screen. The cleaning screen cooperates with the cleaning roll to form the cleaning chamber. The cleaning chamber has one end portion and the other end portion is formed with an inlet and an outlet respectively, for the wheat grain. The outlet is ordinarily closed with a cover plate pushed by a spring in a direction to close the outlet, as shown in diagram (3).

1-Cleaning drum   2-Aperforated cleaning screen
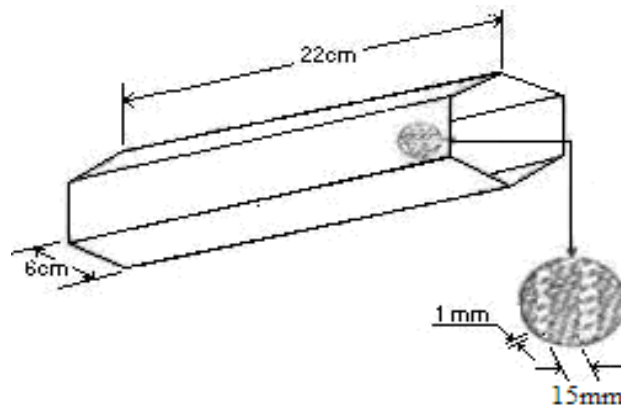3-Hopper holder   4- Screwed iron feed roll
5-The hollow main shaft.
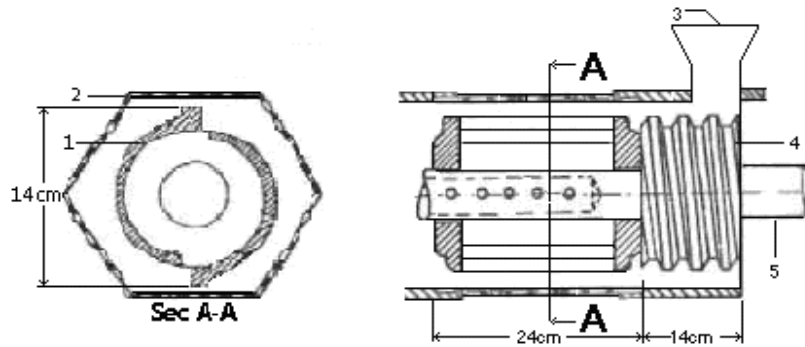
Figure (2):- Friction drum dimensions.
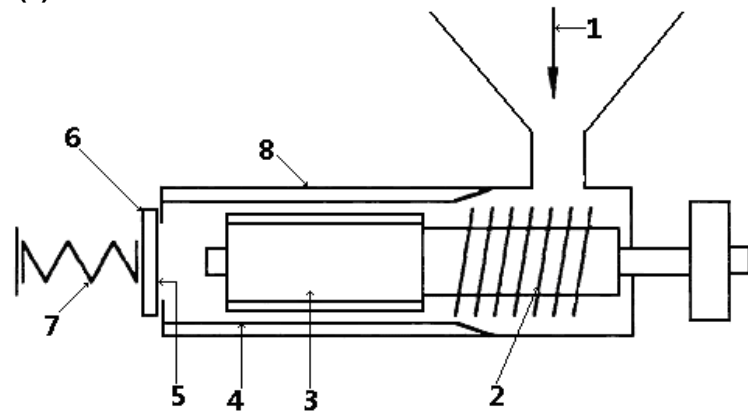
1-Uncleaned wheat grain   2-Feed roll   3-Cleaning drum
4-Apreforated cleaning screen   5-Grain outlet   6-A cover plate
7-A spring   8-Cleaning chamber.
Figure (3): Schematic diagram of the cleaning unit.

Figure (4): Dimensions of the perforated screen

The friction contact of the wheat with the revolving clean roll and the perforated cleaning screen and with itself it heated, so a centrifugal fan is used for cooling wheat to prevent it from becoming spoiled and to achieve final accurate air separation by discharging dust and fine bran into a collecting chamber surrounded the polishing cylinder having a lower portion communicated with an exhaust fan.

Power source and power transmission unit:-
a- Power source

An electric motor of 15 kW (20 hp), 50 HZ and 380 V at rotating speed of 1460 rpm (16.05 m/s), three phase is used. The power is transmitted from the motor directly to a main drive shaft and from it to all other movable parts of the machine by means of cast iron pulleys and V-belts. The electrical motor can be moved on its base to allow adjusting the belt tension.

b - Power transmission unit:-

The electric motor has a pulley 21 cm diameter (O.D) to give the required r.p.m. of the moving parts. The power is transmitted from the electric motor to the pulley 32 cm (O.D) fitted on the main shaft. It changes the roller speed to 958 r.p.m, and from pulley of 34 cm (O.D) fitted on the main shaft to the pulley of 7cm (O.D) fitted on the main cleaning fan drive shaft and consequently changes the cleaning fan speed to 4381r.p.m..

1-3 Specification of crop:-

The form of a wheat grain is nearly ellipsoidal, or egg-shaped. Its longest diameter or length is about double its shortest diameter of thickness.

Table (1): The physical properties of Sakha 93 wheat crop variety with a moisture content of 9.9% during summer season 2008-2009.

Crop conditions	Range	Average
Size of grain-mean (S.D. of 100 grain)		
- Length, mm	6.5 - 8.2	7.46
- Width, mm	2.5 - 4.2	3.37
- Thickness, mm	2 - 3.45	2.65
- Mass of 1000- kernel, g	48.120-48.990	48.596

Studied factors:-
A- Variable factors:-
Moisture content:-
Four levels of moisture content were used. They were about 9. 9, 12.4, 14.9 and 17.6 % (d.p.) named M_1, M_2, M_3 and M_4 respectively.
Pressure on cleaning chamber:-
Four levels of pressure on cleaning chamber were used. They were 1.25, 3.75, 6.25 and 8.75 kN/m^2 named P_1, P_2, P_3 and P_4 respectively.
Friction surface:-
Three levels of friction surface were used. They were smooth with static coefficient of friction (F_1 =0.35); intermediate between rough and smooth (F_2=0.43); and rough surface (F_3=0.51).
Speed of suction air flow:-
Three levels of suction air flow speeds were measured. They were 1.3, 2.8, and 3.4m/s named S_1, S_2, and S_3 respectively. These speeds can be obtained by air adjusting control gate opening. When this its opened it allows air speed to increase, however when closed air speed decreased.
B- Relatively fixed factors:-
   1- Power: - An electric motor of 15 kW (20 hp).
   2- Cleaning roll speed: - were 958 rpm (16.05 m/s).
   3- Clearance between the hexagon casing and the roller: - about 0.9cm.

Methods:-
The experimental procedure that was carried out on the developed machine was cleaning efficiency, damage percentage, polishing percentage and operating cost.
Machine unit measurements:-
The clearance between hexagon screen and cleaning drum:-
For preparing the machine for operation the clearance should be sufficient to minimize grain damage. Starting with a clearance of 0.7, 0.8 and 0.9 cm. If the clearance is too small, the seeds will be broken, and the grain may be lost. Theses three clearance were studied as follows:-
The drum projections height has to be reduced beginning with 0.7 cm, 0.8 and 0.9 cm between hexagon screen and cleaning drum by using a finishing disk. After loosing the drum. The optimum clearance with minimum damage was 0.9 cm.
Static coefficient of friction between wheat grains and friction surface:-
Friction coefficient was measured by method shown in Figure (3-8) on three levels of friction surfaces smooth (F_1); intermediate between rough and smooth (F_2); and rough surface (F_3) at grain moisture content 9.9 %.
The speed of rotating shafts:-
The electric motor has to be moved forward and rearward to be able to match the different pulleys diameter (7, 11.5, 15.5, 21 and 25cm) on its shaft and consequently change the drum speed (301, 494, 666, 902 and 1074 r.p.m) respectively. The optimum speed with minimum damage and sufficient feed rate was 902 r.p.m.

This speeds of rotating shafts were measured by hand contact tachometer which gives the speed in r.p.m. the rotating speed of motor drive shaft, cleaning drive shaft, and fan drive shaft were recorded.

The speed of air flow:-

This speed of air flow at the grain outlet was measured in m/s by anemometer, as shown in figure (3-10). The measurements were taken through the rectangular cross section area of the grain outlet. This area was divided into two portions having dimensions of 13.5 x 10 cm as shown in figure (3-11). The speed of air flow was measured at the center of each portion by introducing the probe of anemometer horizontally to its geometric center. The mean air velocity (Sav) in the rectangular cross section area of the grain outlet is considered as the average speed of two portions.
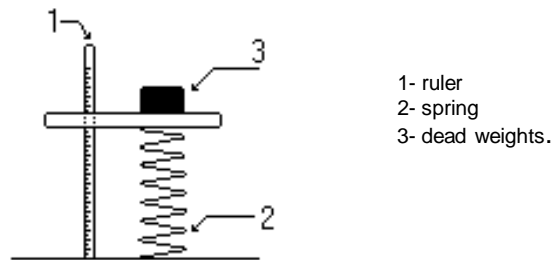
Figure (5): The Anemometer For measuring air speed, m/s.
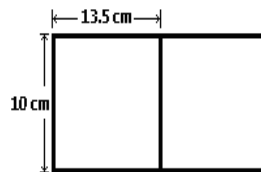
Figure (6): Diminutions of outlet cross section

Stiffness of spring:-

The spring was put vertically on a horizontal plane and after that. Some suitable dead weights were put on it for measuring its displacement as shown on figure (3-12).

1- ruler
2- spring
3- dead weights.

Figure (7): Device for determining the spring stiffness.

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Cleaning processes:-

The feeding was carried out manually. Wheat was fed into the hopper above the spiral feed roll. The cleaning operation is carried out by rotating the feed roll and cleaning drum by means of a motor. The feed roll transports uncleaned wheat grain delivered from above toward the cover plate that closed by a spring. The wheat is cleaned between a screen mounted inside the cleaning chamber and the rotating cleaning roll. An adjustable blade is held in certain position to prevent the wheat swirling round with the cylinder. In consequence of this action, pressure is exerted causing the grain to rub each other. A centrifugal fan was used to achieve final accurate air separation by discharging it to the center of the abrasive roller passing through the cleaning component to a hexagon of cylinder which works as a slotted screen. Dusts and other friction parts were collected in a cyclone beside the machine.

Experimental design:-

Experiments were carried out at El-Serw Agricultural Research station Damietta Governorate. The experiments were carried out on one variety of wheat namely Sakha 93. It was planted during seasons 2008 and 2009 as mentioned before. The tests were carried out at the period from 1-30 June to study the effect of the modified cleaning machine upon the cleaning efficiency, grain damage and polishing percentage as affected by different moisture contents (9.9, 12.4, 14.9 and 17.6 % d.b) named M_1, M_2, M_3 and M_4 respectively; pressures on cleaning chamber (1.25, 3.75, 6.25 and 8.75 kN/m^2) named P_1, P_2, P_3 and P_4 respectively; speeds of air flow (1.3, 2.8 and 3.4m/s) named S_1, S_2 and S_3 respectively and different static coefficient of friction (0.35, 0.43 and 0.51) named F_1, F_2 and F_3 respectively. Three readings (replicates) were taken and all values were scheduled.

The cleaned material was collected after running each experiment and weighted. Then the samples were taken for determining the factors under study.

Measurements:-

To determine the optimum conditions for the wheat cleaning under study, the following calibration criterias were studied: -

     1- Cleaning efficiency, %.
     2- Grain damage, %.
     3- Polishing, %.

Cleaning efficiency:-

To determine the cleaning efficiency (ηcl.), the nonwheat material (Wn.) that remains in the component was separated by hand and weighed then added to the weight of the grain that was cleaned by the machine. Cleaning efficiency was determined according to the following relation:-

Where:-
Wt = total grain weight, g

$$\eta_{cl} = \frac{W_t - W_n}{W_t} \times 100 \quad \rightarrow (1)$$

Grain damage:-

Four samples of 50 grams each were taken from the cleaned grain to determine the mechanical damage (visible) of grain with amplifier.

The damage percentage was calculated as follows:-

$$Damage,\% = \frac{W_{damage}}{W_{total}} x100 \rightarrow (2)$$

Polishing percentage.

The bran layers of wheat were removed sequentially by friction (rubbing kernels against each other) and abrasion operations prior to milling to improve flour refinement.

Four samples of 100 grain each were taken from the cleaned grain to determine polishing, % of grain.

the polishing. % was calculated as follows:-

Where,
W1= The average weight of 100 grain before cleaning, g.
W2= The average weight of 100 grain after cleaning, g.

$$Polishing,\% = \frac{W_1 - W_2}{W_1} \times 100 \rightarrow (3)$$

Statistical analysis:-

All obtained data were tabulated throughout this study after replicated at least three times for each treatment and was analyzed statistically by using a computer program (MINITAB) for estimating the probability.

RESULTS AND DISCUSSION

Data illustrated in figs. (12 to 20) show the comparative magnitude of mean percentage values of cleaning efficiency, grain damage and losses due to polishing.

The relationships between pressures on cleaning chamber, moisture content, suction air speed and friction surfaces on percentage values of cleaning efficiency, grain damage and losses due to polishing can be represented by the following equations, respectively:

Cleaning efficiency, % = 99.0 + 0.0466 P - 0.2690 M + 0.2910 S + 3.450 F, R^2 = 88.6%

Grain damage, % = 7.17 + 0.0266 P - 0.2270 M - 0.0958 S + 1.670 F, R^2 = 98.8%

Polishing, % = 0.52 + 0.0219 P - 0.0340 M + 0.0706 S + 0.941 F, R^2 = 94.3%

Influence of moisture content on the previous parameters:-
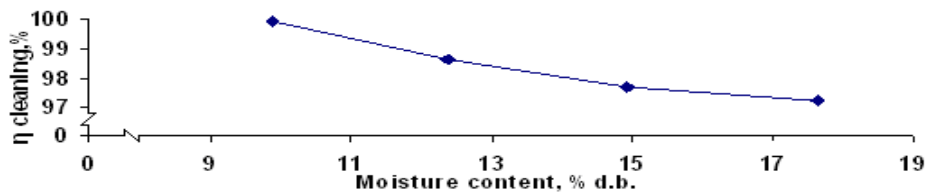**Cleaning efficiency, %:-**

The grain cleanliness, % is the net grain ratio after removing the impurities. The grain cleanliness, % was calculated according to equation (1). Figure (9) showed the effect of moisture content on cleaning efficiency. Results show that increasing in moisture content resulted in decreasing cleaning efficiency and this may be attributed to that a higher moisture content causes grain and impurities (clay particles) to have less dryness to rub against the perforated friction surface as well as against itself. Meanwhile, at a low moisture content, higher cleaning efficiency was obtained. This may

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be due to that low moisture content causes grain and impurities (clay particles) to have enough dryness to rub against the perforated iron friction surface as well as against itself. The maximum cleaning efficiency 99.93% was achieved at moisture content (M1=9.9%). It was remarked that cleaning efficiency,% increased with decreasing moisture content, according to the following descending order M1>M2>M3> M4.The relationship between moisture content and percentage values of Cleaning efficiency,% can be represented by the following equation:

$$\eta_c = 103\text{-}0.35\ M.,\ \ R^2 = 95.3\%$$

Grain damage, %:-

The grain damage, % is the ratio of grain damaged mass to the total mass according to equation (2). The effect of increasing moisture content on grain damage, % showed in figure (10). Results show that grain damage, % decreased as moisture content increased because of the elasticity of grain. Meanwhile at a less moisture content higher grain damage was obtained. The minimum value 3.5 % was achieved at moisture content (M4=17.6%). The grain damage decreased with increasing moisture content, according to the following descending order M1< M2 < M 3< M4.

Fig. (9): Effect of moisture content (M, %) on cleaning efficiency, %.

$$Grain\ damage,\% = 7.5\text{-}0.234M.,\ \ R^2 = 96.7\%$$
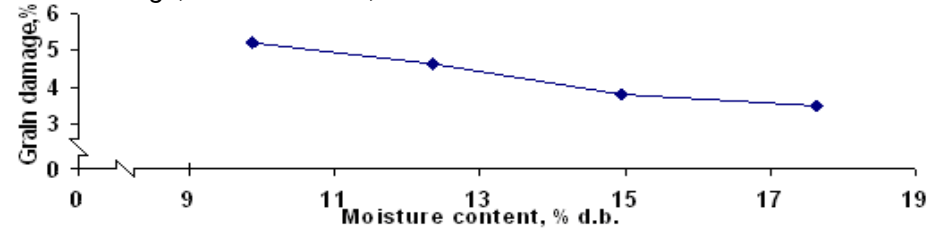
Fig. (10): Effect of moisture content (M, %) on grain damage, %.

Percentage of polishing:-

The polishing **%** is the ratio of the mass losses due to polishing to the total mass, equation (3). Figure (11) shows the effect of increasing moisture content on grain polishing, %. Results show that increasing in moisture content resulted in a decrease in polishing; % and this may be attributed to that a higher moisture content causes to increase a frictional contact force between the wheat grain and causes grain to have higher force to rub against itself as well as against the perforated friction surface. The minimum value 0.41 % was achieved at moisture content (M4=17.6%). It was remarked that

polishing % decreased with increasing moisture content, according to the following descending order M1< M2 < M3 < M4.

*Polishing,%=0.841-0.0257 M., $R^2=92.2\%$*
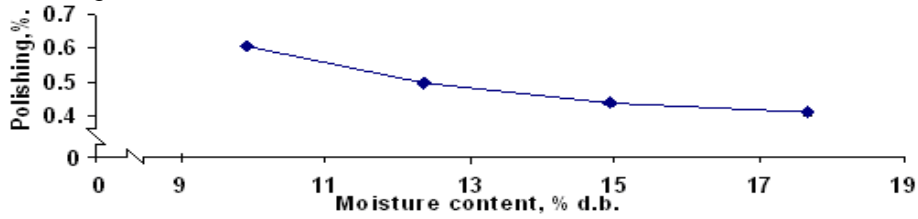
Fig. (11): Effect of moisture content (M, %) on polishing, %.

Influence of pressures on cleaning chamber:-
Cleaning efficiency, %:-

Figure (12) shows the effect of increasing pressure on grain cleaning efficiency, % .Results showed that increasing in pressure resulted to increase in cleaning efficiency, % and this may be attributed to the increased pressure on grain and impurities (clay particles) to rub against the perforated friction surfaces as well as against itself. Meanwhile at a less pressure on lower cleaning efficiency was obtained. The maximum cleaning efficiency 99.93% was achieved at, pressure (P4=8.75 kN/m²). According to the following descending order of pressures, kN/m². P1< P2< P3< P4 the cleaning efficiency increased.

Cleaning efficiency,%= 99.4 + 0.0676 P, $R^2=81.9\%$
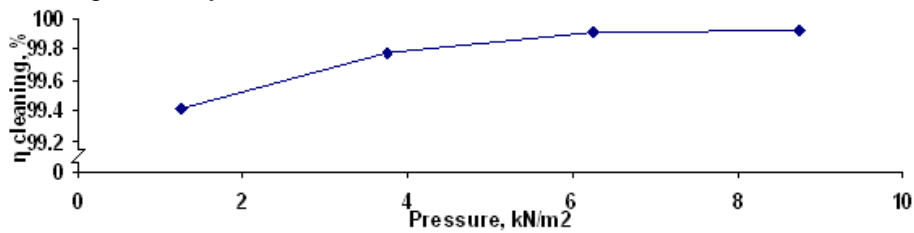
Fig. (12): Effect of pressure on cleaning chamber (P, kN/m²) on cleaning efficiency, %.

Grain damage, %:-

Results in figure (13) showed that the lowest percentage of grain damage was under the lower pressure on cleaning chamber due to less opportunity for grain to damage when rubbed. On the other hand, with higher pressure on cleaning chamber, the grains rub a lot against the perforated friction surfaces. The minimum value 3.5 % was achieved at, pressure (P1=1.25 kN/m²). It was remarked that grain damage, % decreased with decreasing pressures, kN/m² according to the following descending order P1> P2 > P3> P4.
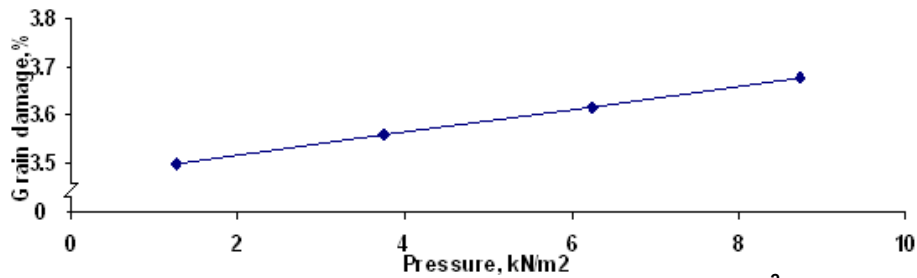
Grain damage,%=3.47+0.024P, $R^2=99\%$

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Fig. (13): Effect pressure on cleaning chamber (P, kN/m^2) on grain damage, %

Percentage of polishing:-

Figure (14) showed the effect of increasing pressure on cleaning chamber on polishing, %. Results showed that the lowest percentage of polishing under the lower pressure is due to less opportunity for grain to friction against the perforated friction surfaces as well as against itself. On the other hand, with higher pressure on cleaning chamber, the grains rub a lot against the perforated friction surfaces and against themselves. The minimum value 0.41 % was achieved at pressure (P1=1.25 kN/m^2). according to the following descending order P1> P2> P3> P4 the polishing,% decreased.

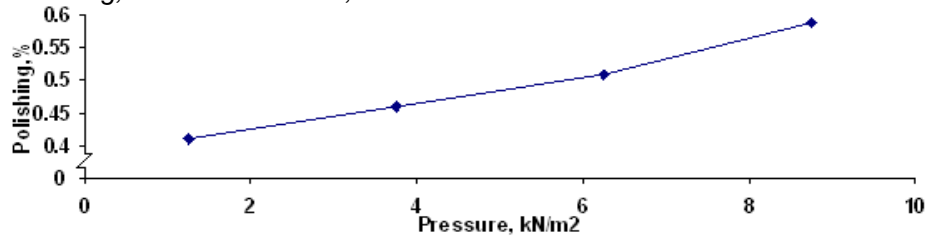*Polishing,%=0.375+0.0236P, $R^2 = 98.5$ %*

Fig. (14): Effect of pressure on cleaning chamber (P, kN/m^2) on polishing, %.

Influence of static coefficient of friction:-
Cleaning efficiency, %:-

Figure (15) showed the effect of static coefficient of friction on grain cleaning efficiency, %. The lowest percentage of cleaning efficiency under the smooth friction surface (F1=0.35), due to less friction that grain faces against the smooth friction surface. On the other hand, with the rough friction surface (F3=0.51), the grain rubs a lot. The maximum cleaning efficiency was 99.93 % at rough friction surface (F3=0.51). It was remarked that cleaning efficiency increased according to the type of friction surface, according to the following descending order F3> F2> F1.

Cleaning efficiency,%=97.9+4F, $R^2 = 99$ %
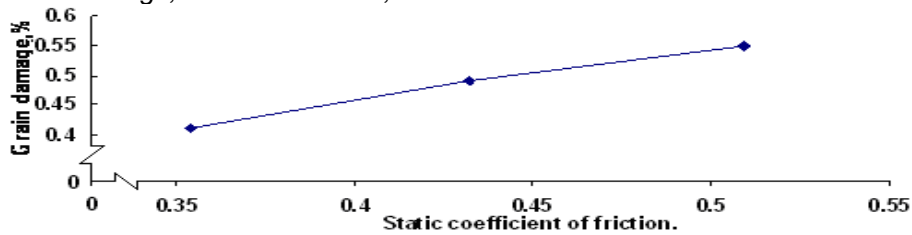
580
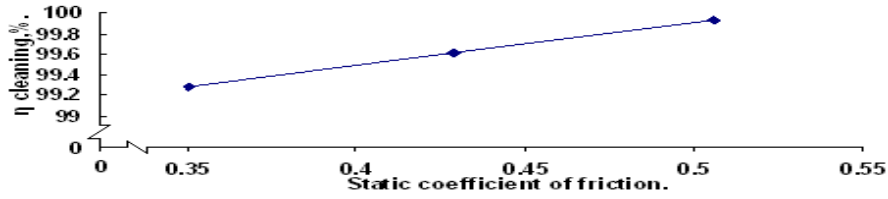
Fig. (15): Effect of static coefficient of friction on cleaning efficiency, %.

Grain damage, %:-

Results in figure (16) showed that the lowest percentage of grain damage under the smooth friction surface (F1=0.35) was due to less friction with the smooth surface. On the other hand, with rough surface (F3=0.51), the friction increased so the damage increase too. The minimum value 3.5 % was achieved at smooth friction surface (F1=0.35). It was remarked that grain damage decreased according to the types of friction surface, according to the following descending order F1> F2> F3.

Grain damage,%= 3.09 + 1.19 F, R^2 =99.2 %

Fig. (16): Effect of static coefficient of friction on grain damage, %.

Percentage of polishing:-

Figure (17) showed the effect of friction surface types on polishing, %. Results showed that the lowest percentage of polishing under the smooth friction surface (F1=0.35) was due to less friction that grain faces against the smooth friction surface. On the other hand, with rough friction surface (F3=0.51), the grain rubs a lot. The minimum value 0.41 % was achieved at smooth friction surface (F1=0.35) by the following descending order F1> F2> F3 for the polishing % decrease.

Polishing,%=0.107+0.875F, R^2 = 99.3%
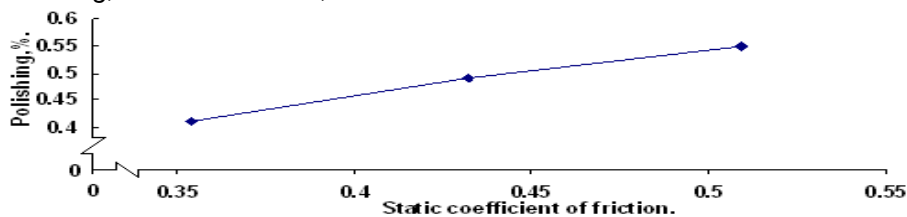
Fig. (17): Effect of static coefficient of friction on polishing, %.

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Influence of suction air speed on:-
Cleaning efficiency, %:-

Results in figure (18) showed that the highest percentage of cleaning efficiency was under the suction air speed (S3= 3.4 m/s) due to the high air suction that grain faces. The maximum cleaning efficiency was 99.93 % at suction air speed (S3= 3.4 m/s).It was remarked that cleaning efficiency increased according to the suction air speed according to the following descending order S1< S2< S3.

*Cleaning efficiency,%=98.2+0.558 S, $R^2 = 94.3\%$*
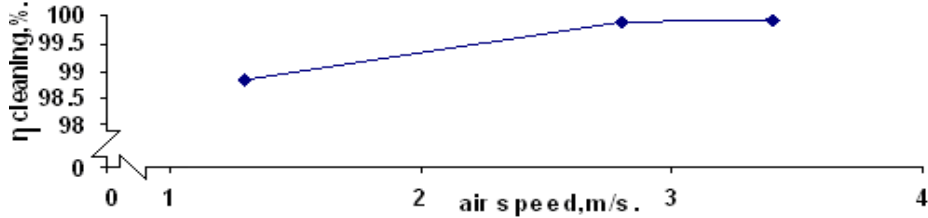
Fig. (18): Effect of suction air speed on cleaning efficiency, %.

Grain damage, %:-

Figure (19) showed the effect of suction air speed on grain damage. Results showed that the lowest percentage of grain damage was under the suction air speed (S3=3.4 m/s) due to less period that grain stays in cleaning chamber. The minimum value 3.5 % was achieved at suction air speed (S3= 3.4 m/s). It was remarked that grain damage, % decreased according to the suction air speed, according to the following descending order S3> S2> S1.The relationship between the friction surface types and percentage values of grain damage can be represented by the following equations:

Grain damage, % = 3.86 - 0.0987S, $R^2 = 88.5\%$
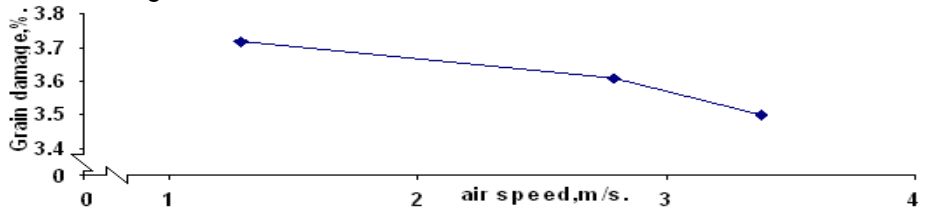
Fig. (19): Effect of suction air speed on grain damage, %.

Percentage of polishing:-

Figure (20) showed the effect of suction air speed on polishing. Results showed that the lowest percentage of polishing was under the suction air speed (S1=1.3m/s) due to the effect of increasing suction air on discharging fine bran into the collecting chamber. The minimum value 0.41 % was achieved at suction air speed (S1=1.3m/s).It was remarked that polishing percentage decreased according to the suction air speed, according to the following descending order S3< S2< S1.The relationship between the friction surface types and percentage values of polishing can be represented by the following equations:

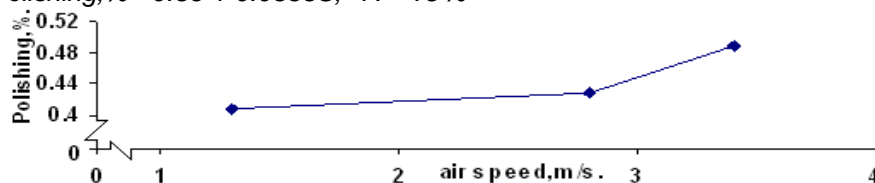*Polishing,%= 0.36 + 0.0333S, $R^2 = 75\%$*

Fig. (20): Effect of Suction air speed on Polishing, %.

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تنظيف حبوب القمح باستخدام آلة تقشير الأرز

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لقد تم تطوير واختبار آلة لتقشير الأرز لاستخدامها في تنظيف حبوب القمح صنف (سخا93). هذه الآلة مكونة من وحدة للتغذية ووحدة للتنظيف ووحدة للقدرة ونقل القدرة. وقد تمت الدراسة باختبار 4 مستويات من الرطوبة في حدود (9.9، 12.4، 14.9، 17.6%) علي أساس جاف وثلاثة معاملات لأسطح الاحتكاك هي علي الترتيب (0.35، 0.51،0.43) وأربع قوي علي غرفة التنظيف هي (1.25،3.75 ،6.25، 8.75 كيلو نيوتن/م²) وثلاث سرعات لهواء السحب هي (1.3، 2.8، 3.4 م/ث). وكانت أعلي نسبة لكفاءة التنظيف هي 99.93% عند محتوي رطوبي 9.9 % وضغط 8.75 كيلونيوتن/م² علي غرفة التنظيف وسطح احتكاك خشن وسرعة هواء سحب 3.4 م/ث. وكانت اقل قيمة لكسر الحبوب هي 3.5 % عند محتوي رطوبي 17.6% وسطح احتكاك ناعم وضغط 1.25 كيلونيوتن/م² علي غرفة التنظيف وسرعة هواء سحب 3.4 م/ث وكانت اقل قيمة لفاقد التلميع هي 0.41% عند محتوي رطوبي 17.6% وضغط 1.25كيلونيوتن/م² علي غرفة التنظيف وسطح احتكاك ناعم وسرعة هواء سحب 1.3 م/ث .

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