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STUDY THE EFFECT OF SOME GRAIN PROPERTIES ON SELECT AND DESIGN SOME PROCESSING EQUIPMENTS

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ABSTRACT

Some main physical, mechanical and aerodynamic properties for Egyptian varieties of grains (Wheat, Giza 168 and Corn, Giza 10) were determined to know it's effective of some processing equipments. The main results in this study can be summarized as follows:-

- 1) The relationship between frontal surface areas, thickness surface area and surrounded surface area were as a function of the product length, width and thickness, 2) In case of the round sieves, the diameter of holes was 3.75 and 7.0 mm while, the distance between two holes was of 5.5 and 10.34 mm at using of wheat and corn, respectively. In case of slot holes of sieves, the dimensions of hole was 8 x3 mm and 14x10.5 mm while the distance between two slot holes was 7.5 x 2.5 mm and 17.6 x 5.0 mm at using of wheat and corn, respectively, 3) The terminal velocity was of 35 and 60 m/s of grains, the grains purity percentage was of 96 and 97 %, and grain losses were of 0.12 and 0.13 % for wheat and corn, respectively, 4) Tempering process of grains due to the moisture content was increased from 11 to 14% for wheat and from 12 to 14% for corn, respectively. This tempering process was required water quantity of 23.25 and 46.5 kg water/ ton grains for tempering of wheat and corn, respectively, 5) The required force for milling process were of 59 and 265 N before tempering process, while it was 50 and 210 N after tempering process for wheat and corn, respectively. 6) The friction angle of silo and hopper was 19 and 16º for wheat and corn, respectively at using steel as material of silo and hopper, 7) The bulk density of grains was 1023 and 1495 kg/m^3 for wheat and corn, respectively. These densities were gave storage capacity of silo 16.1 and 23.5 ton/ (2m diameter X 5 m height of silo), and 8) The study of physical, mechanical and aerodynamic properties is the very important at designed an agricultural machinery. It save the time, powered and labor then it less losses and gave a good grain quality impurities.

INTRODUCTION

Mechanize the separate operation is important due to grain quality. Seeds are the foundation of human and animal life on earth-the food can eat, the fiber we wear, and most of the products used as a daily life, are created from seed. The operation of cleaning was separate grain from chaff and other impurities by air flow, the objective being to obtain the largest possible purity and recovery of the grains.

Helmy (1988) Found that, the local threshing machine is strongly recommended for its good performance. The threshing efficiency, unit energy, total grain damage, unthershed grain and cut straw were 99.1%, 1kW.h/t, 6.5 %, 0.86 % and 22.5%, respectively, at 20.52 m/s cylinder speed and 0.25kg/s feed rate for 18.8% and 13.5% grain and straw moisture contents as an optimum condition of the local threshing machine.

Awady and El Sayed (1994) stated that when air stream is used for separation of product from its associated foreign materials, knowledge of terminal velocity of all particles is involved. For these reasons, terminal velocity has been used as an important aerodynamic characteristic of materials such applications as pneumatic conveying and separation from foreign materials.

Helmy (1995) determined the static coefficient of fraction (SFC) of some Egyptian cereal varieties by using (a) Five different friction surfaces of glass; galvanized metal; plywood, plastic and stainless steel (b) Four different levels of grain moisture content 11, 12, 13 and 14 (w.b) and (d) Four different cereal sample masses of 75, 100, 125 and 150 g. Generally, the increase of grain moisture contents inversed the static friction coefficient significantly. The highest values of static friction coefficient (SFC) were obtained using plywood sheet in all cases, while the lowest values of static friction coefficient were obtained by using stainless steel sheet at the same condition.

Schuler *et. al.* (1995) reported that, there is a positive correlation between flour yield and grain width, but a negative one between flour yield and grain length. The smallest flour yield was obtained from cultivar at arka variety (67.6%), which was characterized by the shortest (5.81mm) grain length. These results also pointed out that specific grain dimension of wheat cultivars might have a significant influence on flour yield.

El-Raie et al (1996*)* determined the terminal velocity of wheat, rice, and barley. They found that the terminal velocity ranged from5.85 to 9.705 m/sec for wheat varieties, from 7.888 to 8.548 m/sec for rice varieties and from 7.49 to 9.953 m/sec for barely varieties.

Ebaid (2001) concluded that the highest purity of 98.8 % and lowest fan losses of 0.13 % were obtained at sieve tilt angle of 5^o degrees, feeding rate of 2.2 t/h, air speed 21 m/s and 110 x 30 cm^2 sieve area. Losses behind sieve increased from 0.11 to 0.128 % with sieve tilt angle increasing from 2 to 8 degrees at feed rate of 2.2 t/h, air speed of 21 m/s and sieve area of 110 x 30 cm^2.

Lischynski et al. (2001) mentioned that the economics of growing wheat are marginal and many people are interested in extracting more value from the crop by utilizing the straw for industrial purposes. Examples of these uses are straw board, pulping and ethanol plants. Results indicated that, as expected, there is a definite relationship between the S/G ratio and the area of the province. The average S/G (straw/grain) ratios for CWRS, CWAD, and CPS as a type of wheat were 1.37, 1.20, and 1.00, respectively.

Nimkar and Chattopadhyay (2001) reported that various physical properties of green gram were evaluated as a function of moisture content in the range of 8.39 to 33.40 % (d.b.). The average length, width, thickness and the mass values of 1000 seed were 4.21 mm, 3.17 mm, 3.08 mm, and 28.19 g, respectively at moisture content of 8.39 % (d.b.). Also, the average geometric diameter increased from 3.45 mm to 3.77 mm, where as sphericity decreased from 0.840 to 0.815.

Helmy *et al.* (2002) reported that physical properties of sugar beet seed such as size, shape, density and projected area may be depended on varieties and condition of growth to great extent. Physical properties are useful for specifying the dimensions and design of metering plate of a planter for sugar beet.

Government of Pakistan (2002) generally, seed has contaminants of various kinds, therefore the cleaning can be done because seeds differ in length, width, thickness, density, shape, surface texture, color, affinity for liquids, and electrical conductivity, but the most commonly used characteristics are seed size and density. Cleaning increases the seed quality by improving physical purity and germination. That means that inert matter must be removed.

Nonami and Nelson (2002) conducted a study to enable easy seed and waste separation at head feed combine by measuring the terminal velocity. It was found that, it is difficult to separate seeds with primary branches and straws from a single seed in the tank. Because the terminal velocity of the seed with primary branches and straw was more than the single seed. The suitable limits of the separating air velocity was from 2.3 to 6.5 m/s.

Santall and Mascheroni (2003) determined the terminal velocity of high oleic sunflower seeds at different levels of moisture content. The results showed that terminal velocity of seeds increased by increasing the moisture content between 2.8 and 5.5 m/s for seeds, between 1.8 and 2.8 m/s for kernel and between 1.1 and 1.9 m/s for hull. Also, they added that drag coefficient decreased when moisture content increased and varied between (4.7 and 1.4) in case of seed and between (12.5 and 3.1) in case of kernel.

Matouk *et al.* (2004) developed the mathematical relationships relating the changes of the properties with the seed moisture content. The seed principal dimensions, mass of 100 seed and seed projection area are generally increased by increasing seed moisture content. However, both shape-index and coefficient of contact surface area decreased by increasing seed moisture content.

ASAE (2005) showed that the level of vacuum must be adjusted so that the pressure difference is sufficient to hold the seed to the plate but allow singulation by the cut-off wiper. Heavier seeds require a greater pressure difference. For a given seed, the smaller the hole diameter, the greater the pressure difference required. The setting of the wiper position is critical to metering performance. Incorrect setting results in either increased incidence of doubles (two seeds per hole) or misses (no seed per hole).

The aim of this study was investigate in the following:

To determine the some physical, mechanical and aerodynamic properties for Egyptian varieties of grains (Wheat, Giza 168 and Corn, Giza 10) to know its effective of some processing equipments. Also, to description shape and size holes of sieves for some grain crops though threshing process.

MATERIALS AND METHODS

The main experiments were conducted at Agricultural Engineering Research Institute, Egypt in season 2007. The experiment and measurements to determine some main physical, mechanical and aerodynamic properties for two Egyptian types of grains (Wheat and Corn) using empirical equation methods. The experiments were carried out according to the following procedures:

1-Grain types, a random sample from two grain types (Five hundred grains) was obtained from Ministry of Agriculture in Egypt, were namely, Wheat (Giza 168- variety) and corn grains (Giza 10-variety). After rejected damaged grains, stones, and other foreign materials by manually. Each grain was measured main dimension to calculate the surface areas (frontal, thickness, and surround surface area).

2-Grain properties, grain sizes were determined by measuring the major axis as length (L), width (W) and thickness (T) for each grain in the sample by using the digital caliber. Volume (V), frontal surface area (A_f) and thickness surface area (A_t) and surrounded surface area (A_S) were calculated. Some Physical and mechanical properties of different grains were listed in Table (1).

Table (1): Average of physical, mechanical and aerodynamics properties of grains.

Type of grain	Length (L), mm	Width (w), mm	Thickness (T), mm	Air speed to remove all impurities, m/s	Air speed to remove grains, m/s	Weight, g	Hardness, N
Corn	12.37	9.89	4.36	13	60	0.413	295
Wheat	6.15	3.45	2.7	4	35	0.030	59

Grain type	Bd, kg/m3	Km, g	Drag coefficient (Cd) , dimensionless.	V	Dg	Da	S	φ	θ	M.C.
Corn	1495	30	0.281 X 10 -4	278.48	7.93	8.87	64.41	16	20	10
Wheat	1023	413	0.156 X 10 -4	30.49	3.79	4.10	61.82	19	24	12

Where:

Dg: Geometric diameter, mm
Da : Arithmetic diameter, mm
S : Percent of spherically, %
φ:External friction angle, degree.
θ : Angle of repose, degree
M.C : Moisture content , %
Bd : Bulk density, g/cm3 (kg/m3)
Km : Mass of 1000 kernels, (g)
Cd: Drag Coefficient, dimensionless
L : Length, mm
W: Width, mm
V : Volume, mm 3

Empirical equation for various grains shapes have bean proposed, based on a large number of measurements, to express the correlation between the three principle dimensions of the grains. The following equations were used to calculate the value of the mentioned properties, El-Raie (1987).

Volume of grain (V, mm3):

$$V = \frac{\pi}{6} L\,W\,T,\ mm^3 \quad \text{------} (1)$$

Geometric mean diameter (dg, mm):

$$d_g = (L\,W\,T)^{\frac{1}{3}},\ mm \quad \text{------} (2)$$

Arithmetic mean diameter (da, mm):

$$d_a = \frac{L + W + T}{3}, \text{ mm} \quad \text{------------------} (3)$$

Spherically percent (S, %):

$$S = \frac{100 (L\,W\,T)^{\frac{1}{3}}}{L}, \ \% \quad \text{------------------} (4)$$

Frontal surface area (Af, mm2):

$$A_f = \frac{\pi}{4} L\,W, \text{ mm}^2 \quad \text{------------------} (5)$$

Thickness surface area (At, mm2):

$$A_t = \frac{\pi}{4} W\,T, \text{ mm}^2 \quad \text{------------------} (6)$$

Surrounded surface area (As, mm2):

$$A_S = \frac{\pi^2}{4} d_g \left(L + d_g\right), \text{ mm}^2 \quad \text{------------} (7)$$

3-Purity and losses grains percentages, purity, is net grains ratio after removing the impurities.

$$\text{Purity}, \% = \frac{\text{Mass of clean grain sample}}{\text{Mass of grain sample before cleaning}} X100 \quad \text{--------} (8)$$

Loss grains, are mass of grain lost with straw.

$$\text{Lossess}, \% = \frac{\text{Grain collected from fan outlet}}{\text{Total grain outlet}} X100 \quad \text{-----------} (9)$$

4- Separation air speed of grains, the terminal velocity of grain and pieces of straw for wheat and corn were measured by the floating apparatus. The aerodynamic property of materials is the suspension velocity (V). The suspensions velocity which is defined as the air velocity required supporting the pieces of material against the action of gravity in vertical air stream may be expressed according to **Hexing (1989)**:-

$$V = \sqrt{\frac{2 M g}{C \rho A}} \quad \text{----------------} (10)$$

Where: V : Suspension velocity, m/s; M : is the mass of the particle, kg;
g: Acceleration due to gravity, m/s^2; C : Drag coefficient dimensionless;
ρ : Density of fluid, kg/m^3; and A : Frontal area of the particle, m^2 ; ;

5-Friction and Repose angles, Friction angle considering of the coefficient of friction between granular materials is equal to the tangent of the angle of internal friction for the materials. The angle of repose is defined as the angle between the base and the slope of the cone formed on a free vertical fall of the grain mass to a horizontal plane, according to Chakraverty (1987).

6-Tempering process, conditioned, a process whereby moisture is added or subtracted as necessary to ensure uniformity in the grain, and to prepare it for the separation of the all components from each others. Method of tempering was depending on adding water to grain for 18 h., according to (Abd El-Kader, 1995) in the following equation:

D1 * W1 = D2 * W2 -------- (11), **X = W2 - W1 ------------ (12)**

Where : D1 = 100 – M1 (M1 : Moisture content before tempering, wb %);

D2 = 100 – M2 (M2 : Moisture content after tempering, wb %);

W1 = weight of grains before tempering, gm;

W2 = weight of grains after tempering, gm; and X = weight of absorbed water, gm.

7-Parameters affecting selection of screen, affecting parameters of sieves selection were calculated as follows according to **El-Raie (1981):**

- **Productivity of sieve** used in the cleaning and sorting process was calculated as follows:

$$Q = q_F * F = q_F * B * L = q_B * B \text{ ------------------------------(13)}$$

Where: Q : productivity of sieve (kg/h),

q_F : specific load of unit area of the sieve per unit time, (kg/h)/dm2

q_B: specific loading per unit width of the sieve, (kg/h)/dm

F : total surface area of screen, dm^2,

B : width of the screen, dm, (500 mm > B > 130 mm),

L : length of the screen, dm (600 mm > L > 2500 mm),and

L/B : is the between length and width of screen , (1.0 > L/B > 3.0)

- **The rpm (n) of crankshaft of screening unit** was calculated from the following formula:

$$n = \frac{30}{\pi}\sqrt{\frac{g}{r} * \tan(\psi - \beta)} \text{ -------------------------------- (14)}$$

Where: r : is the radius of rotation of crankshaft of screening unit in m,

g: is the gravitational acceleration in m/sec^2,

Ψ: is the angle of friction between seed and screen, degree and

β: is the slope angle of the sieve toward horizontal plane, degree .

- **The ideal distribution of holes** may be evaluated by coefficient of live area (μ) according to the following function:-

$$\mu = F_o / F \text{--(15)}$$

Where: F_o: is the total area of the holes on the sieve, cm2 and F: is the total area of the sieve sheet, cm2

- **For round holes,** the ideal distribution of holes may be evaluated by coefficient of live area (μ) according the following equation**:**

$$\mu = \frac{\pi r^2}{2\sqrt{3}(r + m)^2} \text{ ------------------------------(16)}$$

Where: 2r = d : is the diameter of the hole, (0.9 ≤ $\sqrt{d}$)

2m : is the distance between two neighboring holes, (2 m ≤ $\sqrt{2r}$)

- For slot holes, the ideal distribution of holes may be evaluated by coefficient of live area (μ) according the following equation**:**

$$\mu = \frac{h1 * h2}{(h1+e1)(h2+e2)}$$ ------------------------------(17)

Where: h1: is the length of the hole, mm and h2: is the width of the hole, mm

$$\frac{14\,h2}{1+0.2\,h2} \le h1 \le \frac{20\,h2}{1+0.3\,h2}$$ --------------------------(18)

e1 and e2 : is the width of pore spaces between the neighboring holes, (e1 = 1.5 ~3.0 mm at h2 = 1.25 ~ 3.5 mm and 1.00 +0.35 h2 ≤ e2 ≤ 1.35 + 0.42 h2)

Instruments:

Floating apparatus specification, source of manufacture in Japan, Electricity source of power, Work theory by vacuum, maximum measuring in 100 m/s and accuracy 0.1 m/s.

The wind tunnel shutter of grain (the floating apparatus) was used for measuring the terminal velocity of grain and impurities.

Digital venire caliper, it has an accuracy of 0.05 mm. It was used to measure the dimensions of individual grains.

Electronic balance: An electronic balance (made by Japan) was used for weighing samples before and after cleaning. Its scale ranged from 0 to 5 kg max., with accuracy of 0.01 g.

Moisture content meter of grain, it has the following specifications: 1) The moisture tester model is SP – 1D, 2) Manufactured by Japan, 3) Accuracy is ∓ 0.5 %, 4) The power is 220 V , and 5) The ambient working temperature from 0 to 40 ^{o}C.

Grain hardness test, hardness of the grains was tested using hardness tester (model 174886 kiya seisakusho LTD). The hardness value of each sample was recorded in Newton.

RESULTES AND DISCUSSION

1- Physical properties of grain crops:

- Wheat (Giza 168 variety) and Corn grains (Giza 10 variety):

Grains dimensions used in the experiments are shown in Table 1. Maximum dimensions of wheat and paddy rice grains are as following: Length (L) = 7.2 and 13.8, width (W) = 3.45 and 10.5 and thickness (T) = 3.9 and 4.9 mm respectively. From fig. 1 results showed that the percentage of frequency is 45% for wheat and corn grains, at mean grain length of about 6.15 and 12.37 mm, for mean grains width of about 3.45 and 9.89 mm with the percentage of frequency is 50% for wheat and corn grains, and for mean grains thickness of about 2.7 and 4.36 mm with the percentage of frequency is 60 and 45% for wheat and corn grains respectively.

The obtained data of measurements were statistically analyzed to get the values of mean, Standard deviation (SD), and Coefficient of variation

(CV). The main statistical values for physical, mechanical, and aerodynamic measuring properties of grains were shown in table (2) measurements of main dimensions of grain were recorded such as: standard deviation (SD) and coefficient of variance (CV) for length (L), width (W), thickness (T), weight (g), hardness (N), Friction angle (φ) Repose angle (θ) Terminal velocity of grains (G.T.V), and terminal velocity of impurities (I.T.V.). While , the table (3) showed that the main statistical values for physical, mechanical, and aerodynamic calculating properties of grains such as: geometric diameter (D_g), arithmetic diameter (D_a), volume (V), spherically (S), Bulk density (Bd), frontal surface area (Af), thickness surface area (At) and surround surface area (As), the statistical values were allowed under this experimental for all varieties.

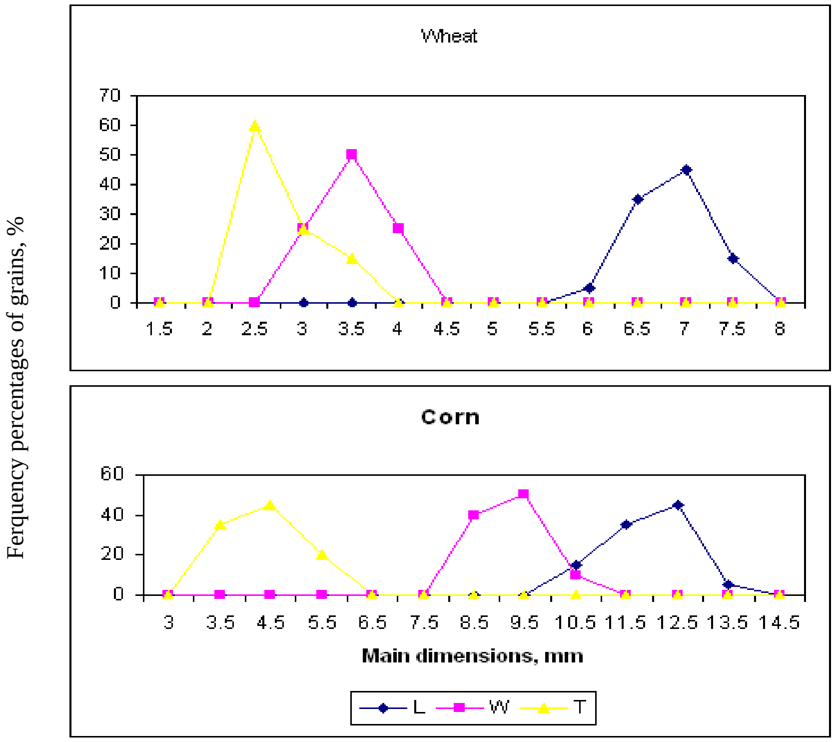

Fig. (1): Frequency of main dimension for different type of grain crops.

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2- Relationship between surface areas and main dimensions:

The obtained results from the main dimensions for two grains varieties to calculate surface areas by empirical equations as the follows:

The relationship between frontal surface areas (Af), thickness surface area (At) and surrounded surface area (AS) were as a function of the product of length (L) and width (W) and thickness (T) by the following equations:. These relations are possible its using for designed feeding unit of seedling, screen unit of thresher and grading machines.

For grains of wheat Giza 168 Variety:

$$Af = 0.440\, L^2 = 1.411\, W^2 = 2.293\, T^2 \quad \text{-(19)}$$

$$At = 0.195\, L^2 = 0.617\, W^2 = 1.002\, T^2 \quad \text{(20)}$$

$$As = 2.470\, L^2 = 7.943\, W^2 = 12.861\, T^2 \; ; \quad \text{(21)}$$

For grains of Giza 10 corn Variety:

$$Af = 0.631\, L^2 = 0.984\, W^2 = 5.168\, T^2 \quad \text{-(22)}$$

$$At = 0.227\, L^2 = 0.347\, W^2 = 1.791\, T^2 \quad \text{(23)}$$

$$As = 2.610\, L^2 = 4.078\, W^2 = 21.244\, T^2 \; ; \quad \text{(24)}$$

3- Effect of dimension of grains on sieves separation:

Generally, grain has contaminants of various kinds; therefore the cleaning can be done because grains differ in length, width, thickness, density, shape, surface texture, and color. But the most commonly used characteristics are grain size and density. Cleaning increases the grain quality by improving physical purity and germination. Table (4) showed that using maximum of grains dimensions to design holes of sieves which used to cleaning and separation of grain.

Table (4): Calculate some parameter affecting on select sieves for different grains

Type of grain	Calculate Dimension of sieves								
	Q, kg/h	**L, cm**	**W, cm**	**Qf, kg/h**	**Qb,kg/h**	**F, m2**	**B,mm**	**L, mm**	**L/B**
Wheat	900	110	30	27	300	0.33	300	1100	3.6
Corn	820	110	30	25	273	0.33	300	1100	3.6

	Calculate Rotation Speed Crank Shaft, rpm					
	Fric.,angle	Coe. Fric.	Sieve angle	R.C.shaft, mm	G, m/s2	N, rpm
Wheat	19	0.344	6	17.5	9.81	436
Corn	16	0.286	8	17.5	9.81	340

	Distribution of round holes on sieves.					
	L, mm3	Dia., mm	µ	r, mm	m, mm	2m, mm
Wheat	7.20	7.50	0.30	3.75	2.75	5.50
Corn	13.80	14.00	0.30	7.00	5.17	10.34

	Distribution of slot holes on sieves.					
	L, mm	h1,mm	W, mm	h2.mm	e1,mm	e2, mm
Wheat	7.20	7.50	4.00	4.00	7.50	2.75
Corn	13.80	14.00	10.50	10.50	17.60	5.00

In case of the round sieves, the diameter of holes was 3.75 and 7.0 mm while the distance between two holes was of 5.5 and 10.34 mm at using of wheat and corn grains.

In case of slot holes of sieves, thje area of hole (length (h1) X width (h2)) of hole was (7.5x4 mm) and (14x10.5 mm) while the area between two slot holes was (length (e1) X width (e2)) was of (7.5 x 2.75 mm) and (17.6 x 5.0 mm) at using of wheat and corn grains.

4- Effect of the aerodynamic properties on grains:

Figs (2) and (3) show the determined of terminal velocity for wheat and corn grains and its impurities. For grains, the higher mean terminal velocity of grains was 60 and 35 m/s for corn and wheat grains. But, for the impurities of crops, the higher mean of terminal velocity was 13 and 5 m/s for corn and wheat grains. Also, it noticed that by increasing weight of grains the terminal velocity was increased. The terminal velocity was of 60 and 35 m/s at weight of grain was 0.413 and 0.030 g for corn and wheat grains. As well as, figs showed that the terminal velocity was 35 and 60 m/s of grains, the purity percentage was of 96 and 97%, and losses of grains were of 0.12 and 0.13 % for wheat and corn grains.

5- Effect of tempering process on milling process:

Figs (4) and (5) showed that the increases the moisture content by tempering process was affecting on milling process. The moisture content was increased from 11 -14 and 12 – 14% for milling of wheat and corn grains. This tempering process was required water quantity of 23.25 and 46.5 kg water/ Ton grains for tempering of wheat and corn grains.

Figs (6) and (7) showed that it was noticed that the required force for milling process was different before and after tempering process. The required force was 39, 59, 265, and 225 N before tempering process, while it was 50 and 210 N after tempering process. That mean the reduction required force percentage was 14.29 and 28.8% at milling process of wheat and corn grains.

6-Effect bulk density on storage capacity (2 m diameter x 5 m height):

Table (5) and fig (8) showed that the different bulk density of grains was important to know the storage capacity of silos, it was noticed that the bulk density of grains was of 1023 and 1495 kg/m^3 for wheat and corn grains. These densities were gave storage capacity of silo 16.1 and 23.5 ton/silo. Where, the separation of grains depends on densities differentiation by using centrifugal force.

Table (5): Required force for milling process and storage capacity of grains.

Type of grain	Some parameter of required force for milling					
	S.M.C.,%	**M.M.C.,%**	**A. water, kg/ton**	**H.B.M,N**	**H.A.M,N**	**Reduction force, %**
Wheat	12	14	23.25	59	50	14.25
Corn	10	14	46.5	265	210	28.8
	Some parameters of required storage capacity					
	Fric. Angle	Coeff. .friction.	Repose angle	Bd, kg/m^3	Storage capacity (2X5 m), ton	
Wheat	19	0.344	24	1023	16.061	
Corn	16	0.286	20	1495	23.471	

7- Friction, repose of angles and hardness.

The frictional resistance is characterized by the friction coefficient Effect of friction angle on cone designed of silo and hopper discharges were in table (5) and fig (9) that the slope of outlet (discharge of silo and hopper) depend on friction angle was of different from grain to other. The friction angle (slope angle) of silo and hopper was 19 and 16 º for wheat and corn grains at using steel as material of silo and hopper.

Conclusion

Concluded of this study was found the following:

The relationship between frontal surface areas (Af), thickness surface area (At) and surrounded surface area (AS) were as a function of the product of length (L) and width (W) and thickness (T). These relations are possible its using for designed feeding unit of seedling, screen unit of thresher and grading machines.

In case of the round sieves, the diameter of holes was 3.75 and 7.0 mm while, the distance between two holes was of 5.5 and 10.34 mm at using of wheat and corn grains. In case of slot holes of sieves, this area of hole (length (h1) X width (h2)) of hole was (7.5x4 mm) and (14x10.5 mm) while the area between two slot holes was (length (e1) X width (e2)) was of (7.5 x 2.75 mm) and (17.6 x 5.0 mm) at using of wheat and corn grains.

The higher mean terminal velocity of grains was 60 and 35 m/s for corn and wheat grains. While, the higher mean of terminal velocity was 13 and 4 m/s.

The terminal velocity was decreases of 60 and 35 m/s followed with decreases the weight of grain was 0.413 and 0.030 g for corn and wheat grains.

By increases the terminal velocity was of 35 and 60 m/s of grains, the purity percentage was increased of 96 and 97 % and fan losses increased from 0.12 and 0.13 % for wheat and corn grains.

Tempering process of grains due to the moisture content was increased from 11 -14 and 12 - 14% for wheat and corn grains. This tempering process was required water quantity of 23.25 and 46.5 kg water/ ton grains for tempering of wheat and corn grains.

The required force for milling process were of 59 and 265 N before tempering process, while it was 50 and 210 N after tempering process. That mean the reduction required force percentage was 14.29 and 28.8 % at milling process of wheat and corn grains.

The friction angle (slope angle) of silo and hopper was 19 and 16º for wheat and corn grains at using steel as material of silo and hopper.

The bulk density of grains was of 1023 and 1495 kg/m3 for wheat and corn. These densities were gave storage capacity of silo 16.1 and 23.5 ton/silo (2 m diam. x 5 m height).

The study of physical, mechanical and aerodynamic properties is the very important at designed an agricultural machinery. It save the time, powered and labor then it less losses and gave a good grain quality impurities.

Fig. (2): Relationship between terminal velocity and grain weight.

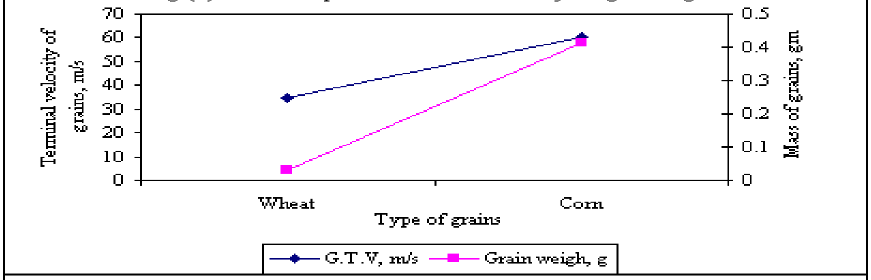


Fig. (3): Relationship between terminal velocity and purity and losses of grains.

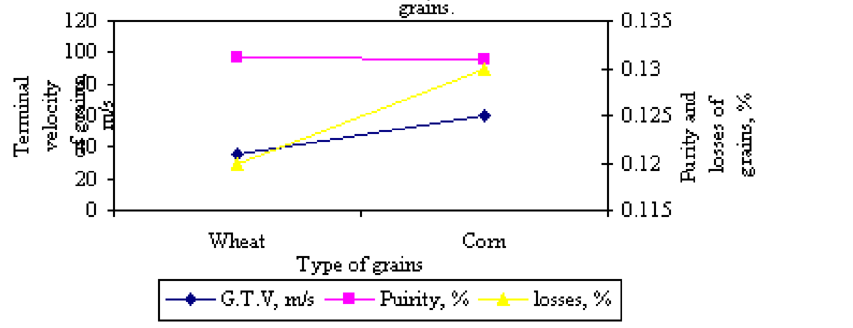


Fig. (4): Moisture contentof grain before and after tempering process.

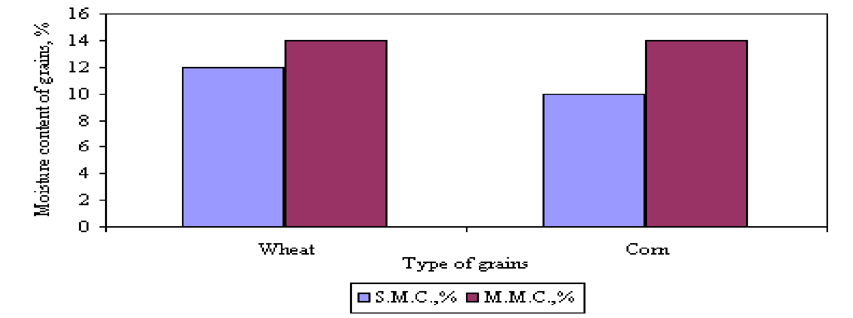


Fig.(5) : Shows quantity of added water to grain through tempering process.

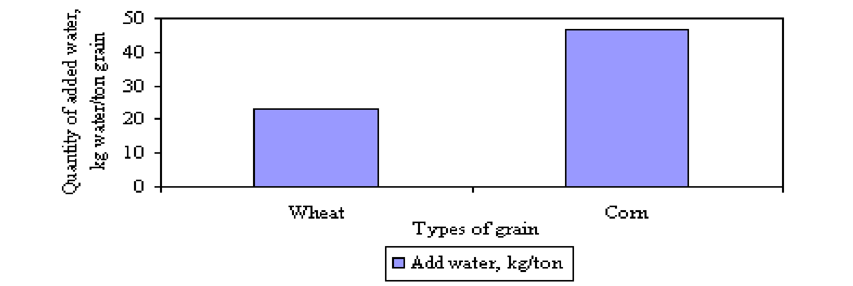


Fig. (6): Hardenss force of grains before and after tempering process, N

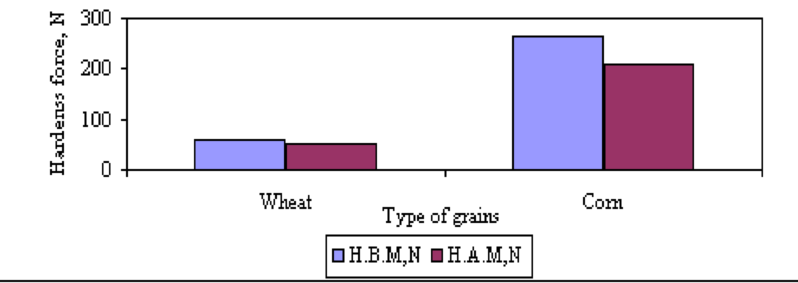


Fig. (7) : Reduction of grain milling force after tempering process.

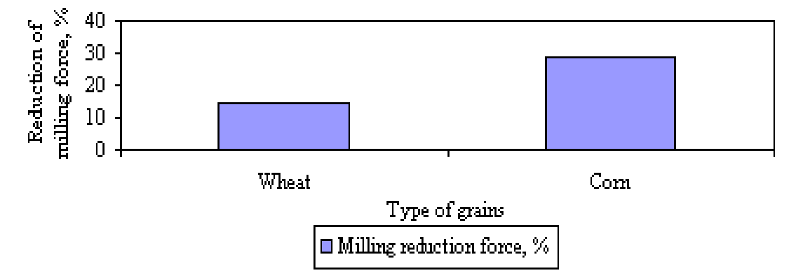


Fig. (8): Relationship between bulk density and storage capacity.

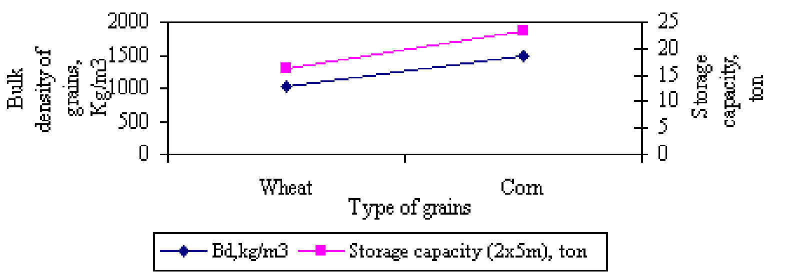
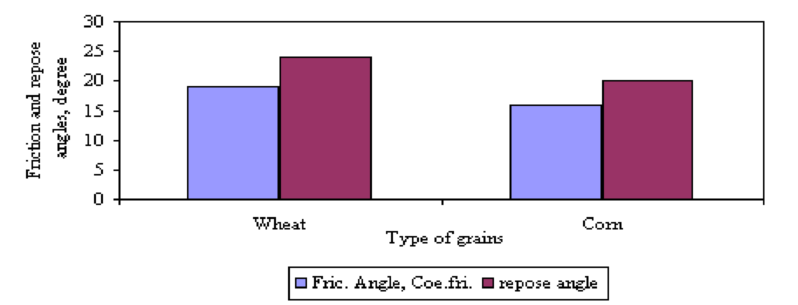


Fig. (9): Show the Friction and repose angles of grains.



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دراسة تأثير بعض خصائص الحبوب على إختيار وتصميم بعض معدات التصنيع

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لقد زاد الأهتمام بعملية فصل الحبوب بهدف زيادة جودة إنتاجية محاصيل الحبوب. ، و تهدف هذه الدراسة الى:

١) ايجاد مساحات اسطح بعض محاصيل الحبوب المختلفة (مساحة السطح الأمامية ، ومساحة السطح السمكية ، ومساحة سطح المقطع العرضى) باستخدام المعادلات التجريبية والتى تعتمد على عدد كبير من القياسات للأبعاد الأساسية للبذور باستخدام القدمة ذات الورنية.

٢- دراسة تأثير بعض الخصائص الطبيعية والميكانيكية والأيرودياميكية على عمليات اختيار وتصميم الغرابيل ، ومعدات الفصل.

وتمت الدراسة على النحو التالى :

١) المحاصيل موضع الدراسة القمح (جيزة ١٦٨) الذرة ، و (جيزة ١٠ هجين فردى)، تم اختيار العينات من قسم بحوث الحبوب (٢٠٠٧) ، معهد المحاصيل الحقليه وتم تجهيز العينات بتنظيفها من الأتربة.

٢) تم قياس بعض الخصائص الطبيعية والميكانيكية لهذه المحاصيل : الطول ، العرض ، والسمك . كما تم حساب الحجم ، القطر الهندسى ، والقطر الحسابى ، نسبة التكور ، الكثافة الظاهرية والكثافة الحقيقية و وزاوية الأحتكاك وزاوية الكويم ودرجة الصلابة وذلك عند المحتوى الرطوبى ١٠ % للذرة ، ١٢ % للقمح.

٣) تم تقدير السرعة النهائية للهواء اللازمة لرفع الحبوب وتعليقها وأيضا تم تقديرها للشوائب لتقدير نسبة نظافة وفواقد الحبوب.

٤) قياس درجة صلابة الحبوب قبل وبعد عملية ترطيب الحبوب لتقدير القوة المطلوبة لعملية الطحن.

أوضحت النتائج المتحصل عليها الأتى :

- من أبعاد الحبوب الرئيسية يمكن التوصية باستخدام فتحات غرابيل مستديرة بقطر فتحات كالتالى : ٣,٧٥ ، ٧ مم بينما كانت المسافة بين كل فتحتين كالتالى : ٥,٥ ، ١٠,٣٤ مم لمحاصيل القمح والذرة على الترتيب. كما تم تقدير فتحة الغرابيل فى حالة الفتحات المستطيلة الشكل بابعاد (طولx عرض) كالتالى: (٧,٥ x ٤ مم) ، (١٤ x ١٠,٥ مم) بينما كانت المسافة بين كل فتحتين على شكل مستطيل ابعاده (طولx عرض) كالتالى: (٧,٥ x ٢,٧٥ مم) ، (١٧,٦ x ٥ مم) عند تصميم غرابيل دراس وتذرية محاصيل حبوب القمح والذرة على الترتيب.
- كما وجد ان السعة التخزينية لمحاصيل الحبوب تتأثر باختلاف الكثافة الظاهرية للحبوب حيث كانت ١٦. ، ٢٣,٥ ، ١٨,٧ طن / صومعة (قطرها ٢ م وارتفاعها ٥ م).
- وجد ان قيم معامل احتكاك الحبوب كان ٠,٣٤٤ ، ٠,٢٨٦ لحبوب القمح والذرة على الترتيب مع مادة معدن حديد ومنها يمكن التوصية بزاوية ميل فتحات التغذية وتصرف الحبوب حوالى ١٩ ، ١٦ ٥ لحبوب القمح والذرة على الترتيب.
- وجد ان عملية ترطيب محاصيل الحبوب تتطلب كمية من الماء حوالى ٢٣,٢٥ ، ٤٦,٥ كج ماء / طن حبوب والتى تؤدى الى زيادى المحتوى الرطوبى من ١١ الى ١٤% لحبوب القمح ، من ١٢ الى ١٤% لحبوب الذرة . مما ادى الى نسبة التخفيض فى القوة المطلوبة لعملية الطحن من ٥٩ نيوتن عند رطوبة ١١ % رطوبة الى ٥٠ نيوتن عند رطوبة ١٤% لحبوب القمح ومن ٢٦٥ نيوتن عند ١٢% رطوبة الى ٢١٠ نيوتن عند رطوبة ١٤%.
- وجد ان سرعة الهواء اللازمة لتعليق الحبوب ٦٠ ، ٣٥ م/ث وكذلك الشوائب لنفس الحبوب كانت ١٣ ، ٤ م/ث لمحاصيل حبوب الذرة و القمح على التوالى ، وبالتالى فان سرعة الهواء (اكبر من ١٣ م/ث واقل من ٦٠ م/ث) ، (اكبر من ٤ م/ث واقل من ٣٥ م/ث) ، صالحة لإزالة جميع الشوائب من حبوب الذرة والقمح على الترتيب.. مما ادت الى نسبة نقاوة الحبوب كانت ٩٦ ، ٩٧ % ونسبة الفقد فى الحبوب كانت ٠,١٢ ، ٠,١٣ % لحبوب الذرة و القمح على التوالى.
- أمكن استنتاج معادلات رياضية يمكن من خلالها التنبؤ بصفات المساحات الأمامية والسمكية والعرضية.. وهذه المعادلات يمكن أن تفيد الباحثين عند تصميم وحدات التلقيم بالآلات الخاصة الزراعة ووحدات الغرابيل الخاصة بآلآت تنظيف وتدريج الحبوب.
- كما تعتبر دراسة الخصائص الطبيعية والميكانيكية والأيروديناميكية من العمليات الزراعية الهامة حيث انها توفر الوقت والجهد والعمالة وتقلل الفواقد وتزيد درجة النظافة. لتوفير اصناف عالية النقاوة وخالية من اى شوائب.

Table (2): Main statistical values for physical, mechanical, and aerodynamic measuring properties of grain crops.

Main statistical Values	Length (L), mm	Width (W), mm	Thick. (T), mm	Weight (g), gm	Hardness, N	Friction angle, degree	Repose Angle, degree	Grain T.V., m/s	Impurities T. V., m/s
	Wheat Giza 168 variety								
Min	5.5	2.7	2.2	0.02	44.9	17	22	34	3
Max	7.2	4	3	0.04	75.6	21	26	36	5
Ave.	6.15	3.45	2.7	0.03	59	19	24	35	4
S.D	0.486	0.417	0.254	0.008	9.744	1.333	1.155	0.816	0.816
C.V,%	0.079	0.121	0.094	0.272	0.165	0.070	0.048	0.023	0.204
	Corn, Giza 10 variety								
Min	10.5	9	4	0.359	230	14	18	58	12
Max	13.8	10.5	4.9	0.462	339	18	22	62	14
Ave.	12.37	9.89	4.36	0.413	295	16	20	60	13
S.D	1.040	0.563	0.331	0.034	34.393	1.155	1.333	1.155	0.816
C.V,%	0.084	0.057	0.076	0.082	0.117	0.072	0.067	0.019	0.063

Table (3): Main statistical values for physical, mechanical, and aerodynamic calculating properties of grain crops.

Main statistical Values	Af, mm2	V, mm3	dg, mm	da,mm	s,%	Bd, g/mm3	At,mm2	As.mm2
	Wheat Giza 168 variety							
Min	11.657	17.097	3.160	3.467	57.452	0.000512	4.663	67.450
Max	20.912	39.036	4.149	4.567	67.786	0.001445	9.185	116.081
Ave.	16.739	30.486	3.799	4.100	61.816	0.001020	7.377	93.683
S.D	2.900	7.307	0.327	0.337	3.496	0.000289	1.457	14.538
C.V,%	0.173	0.240	0.086	0.082	0.057	0.283532	0.198	0.155
	Corn Giza 10 variety							
Min	77.715	237.384	7.528	8.300	59.749	0.001193	28.260	351.502
Max	113.747	326.073	8.360	9.533	74.236	0.001795	37.680	456.628
Ave.	96.159	278.477	7.927	8.873	64.406	0.001495	33.820	397.158
S.D	11.009	29.608	0.274	0.398	4.685	0.000193	2.802	36.015
C.V,%	0.114	0.106	0.035	0.045	0.073	0.129323	0.083	0.091