DESIGN AND DEVELOPMENT OF UNIT FOR EXTRACTING WHEAT GERM OIL

By

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B.Sc. Agric. Sc. (Agric. Eng.), Menoufia University, 2000.

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ABSTRACT

Abdel-gawad Mohammed Abdel-gawad Saad: Design and Development of Unit for Extracting Wheat Germ Oil. Unpublished Ph.D. Thesis. Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2012.

An expelling machine for extracting oil from wheat germ was designed and fabricated to be suitable for young investors. The procedures include the design stages, construction and testing. The main machine components are: Hopper (feeding inlet); expellant unit and an electric motor. The power is transmitted by means of a set of pulleys; sprockets; V-belt; chain and speed reducer (gear box). The expelling unit consists of two screw expellant shafts with two expellant barrels.

The expelling machine evaluated at five screw speeds (25, 35, 45, 55, and 65 rpm); four levels of press head clearance (0.5, 1, 1.5, and 2 mm); studying influence of the preheating process (in the range of 60-70°C) by the water at different atmospheric steaming periods (0, 10, 20, and 30 min) to change the initial moisture content of raw material (13.2%) to different levels (15.4, 16.2, and 16.8%). and influence of heating stabilization process (9.5% of moisture content) on expelling machine performance to determine the best Machine capacity (kg/h); Oil recovery (%); Residual oil (%); Oil productivity(L/h); Specific energy consumption (kWh/kg_{feed}); and Barrel temperature(°C). also, determine the economic feasibility for developed expelling machine.

Results showed that the expeller could be pressed wheat germ on two stages to give a better performance at as following.

1- The maximum machine capacity (42.6 kg/h) was obtained from stabilized wheat germ (9.5% moisture content) at 2mm outlet clearance and 65 rpm of screw speed.
2- The maximum oil recovery (63%) was obtained from stabilized wheat germ (9.5% moisture content) at 0.5mm outlet clearance and 25 rpm of screw speed.

3- The maximum oil productivity (2.36 L/h) was obtained from stabilized wheat germ (9.5% moisture content) at 2mm outlet clearance and 65 rpm of screw speed.
4- The minimum SEC (0.0304 kWh/kg_{feed}) was found from wheat germ (13.2% moisture content) at 2mm outlet clearance and 65 rpm of screw speed.
5- The minimum barrel temperature (51.1°C) was found from raw wheat germ (13.2% moisture content) at 2mm outlet clearance and 25 rpm of screw speed.

Keywords: Oil Extraction, Expelling machine Design, Wheat Germ Oil, Economic Feasibility.

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Abdel-Gawad Mohammad Saad

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V	The flow rate of fluid, m^3/sec.
R	Pore radius, m
ΔP	Pressure drop across a pore of length, Pa
L	Pore length, m
μ	Coefficient of viscosity, Pa.sec
L_p	Hydraulic conductivity of plasmodesmate, m^3/sec. Pa
q	The flow rate of fluid
k	The coefficient of permeability
ρ	Fluid density
g	Gravitational acceleration
$\frac{\Delta u}{\Delta z}$	Hydraulic gradient in the fluid (pressure difference Δu over distance ΔZ).
σ_t	Total applied pressure,
σ_i	Kernel pressure; the pressure carried by the medium skeleton
U	Inter-kernel fluid pore pressure; the pressure carried by the medium fluid
Q_T	Theoretical volumetric flow rate of wheat germ, cm^3/h.
ṁ	The maximum required mass flow rate
ρ_g	Wheat germ bulk density, g/cm^3
η_f	Feeding efficiency
η_v	Hopper volume efficiency
t_{int}	Time interval between filling and re-filling up the hopper
Q_{act}	Actual volumetric flow rate of wheat germ, cm^3/h
V_H	The hopper actual volume, cm^3
D_h	Upper hole diameter of the hopper, cm.
h_h	Height of hopper, cm.
x	Sidelong length of the hopper, cm
θ	The inclination angle of hopper
φ	The repose angle.
Ƥ	Screw pitch
N	Number of turns of screw.