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Broin & Associates Inc.
2209 East 57th St. North
Sioux Falls, SD 57104

PROPOSAL

STATIC FLUID BED DRYER/COOLER

for

CORN GERM

for

BROIN & ASSOCATES INC.

Barr-Rosin Quotation No: E03047

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1.0 CLARIFICATIONS TO PROPOSAL

Outlined below are the Barr-Rosin clarifications to proposal.

1. Our proposal is based on preliminary design assumptions that the germ particles would be similar to the wet milled material. The small sample we received had roughly the same particle size range but contained about 25% by mass of foreign material. We understand that this would be removed in your new process.
2. The system has been sized to produce 3500 lb/hr of product at 3% moisture with an inlet feed moisture of 20%.
3. We have included a single cyclone for particulate removal from the exhaust air. A sample and detailed particle size distribution would be required to estimate collection efficiency.
4. All fan motors and frequency inverters have not been included.

2.0 FLUID BED DRYER SPECIFICATION

2.1. Performance Data

The fluid bed dryer would be designed for the following capacity:

Parameters		
Feed Rate	4,244	lb/hr
Feed Moisture Rate	20	% wt
Product Rate	3,500	lb/hr
Product Moisture Content	3	% wt
Evaporative Capacity	744	lb/hr
Dryer Air Inlet Temperature	375	°F
Dryer Exhaust Temperature (average)	200	°F
Cooler Inlet Air Temperature	Ambient	
Dryer Exhaust Volume	9,500-12,700	ACFM
Cooler Exhaust Volume	3,800	ACFM
Total Installed Motors-Dryer	126	HP
Total Installed Motors-Cooler	25	HP
Normal Absorbed Power-Dryer	71	BHP
Normal Absorbed Power-Cooler	16	BHP
Heat Duty (-10°F)	3.2	MMBtu/hr
Natural Gas Consumption	162	lb/hr

Notes:

1. Moistures are on a wet basis and free moisture content.
2. Gas consumption based on a natural gas heat value of 19,695 Btu/lb. LHV

15 lbs pressure on burner

2.2. Material Properties

Material Specific Heat (assumed)	0.43 Btu/lb·°F
Bulk Density	32 lb/ft^3

2.3. Utilities

The following utilities will be required for the fluid bed :

Description	Condition
Fuel Source	Natural Gas
Electrical power - motors	480V, 3 ph, 60 Hz (up to 200 HP) 4160V, 3 ph, 60 Hz (above 200 HP) 120V, 1 ph, 60 Hz (controls)
Compressed Air	90 psig

A breakdown of the installed and anticipated absorbed motor HP requirements is provided below. Refer to Appendix A for more detail.

Description	Installed Power	Absorbed Power
Fluid bed	126 HP	87 HP

2.4. Site Conditions

The system would be designed for the following site conditions: -

Description	Conditions
Location	Scotland, SD
Dryer Location	Indoors
Winter Ambient Temperature (minimum)	-20 F
Summer Dry Bulb Temperature (maximum)	92 F
Summer Wet Bulb Temperature	78 F
Elevation above sea level	1348
Area Classification	Non-hazardous
Electrical Protection	NEC Class I, Division I, Group G

3.0 DESCRIPTION OF OPERATION

3.1. Fluid Bed Description

A static fluid bed is proposed to meet the specified design duty listed in *Section 2.1 Performance Data*. Below we have provided a brief system description of the drying system.

Wet corn germ would be received at a constant rate from the customer's upstream process and would enter the first section of the bed where it would be fluidized by hot process air. The particles would be dried while being fluidized by this air and conveyed along the bed. Multiple fluidizing zones would be provided to ensure optimum fluidization along the bed. Dried germ would leave the unit by passing over an adjustable discharge weir. Bed depth and residence time within the fluid bed would be controlled by adjusting the height of the discharge weir.

Atmospheric pressure would be maintained in the unit, thereby eliminating the need for air seals at the feed inlet and product outlet. A controllable flow of process air would be supplied to the fluidized bed unit by the forced draught fan. Prior to entering the drying section, fresh air would be raised to the required temperature in a gas-fired heater.

An integral cooling section would be provided in the bed following the drying zone using ambient air as the cooling medium. Air would be supplied to the bed via a forced draft fan. The combined cooler and dryer exhaust air would be pulled through a cyclone by an induced draft fan. Air borne fines would be collected in the cyclone and discharged through a rotary valve. Cool product is discharged from the bed over the discharge weir.

3.2. Dryer Control Philosophy

The fluid bed control philosophy would incorporate the following.

- Temperature control loop: to maintain a constant exhaust temperature and modulate the inlet temperature (gas valve) with respect to evaporative rate.
- Pressure control loop: slightly sub-atmospheric conditions would be maintained at the feed point, preventing escape of hot gases and eliminating the need for an air seal by means of a balanced system of forced and induced draught fans.

4.0 EQUIPMENT SPECIFICATION

Outlined below is the equipment specification for the Barr-Rosin vibrating fluid bed drying system that would be supplied to achieve the desired drying capacity:

4.1. Fluid Bed

4.1.1. Inlet Filter – 24 sq.ft.

One – of the medium efficiency element type (Farr 30/30 or equivalent) for removing particulates from the incoming fresh air. The filter would be supplied complete with removable elements mounted in a galvanized steel housing. Inlet louvers would be provided to prevent the ingress of rain.

4.1.2. Cold Air Duct

One – approximately 10 ft. long, of carbon steel construction, connecting the fresh air intake to the forced draft fan. Supplied in flanged sections and stiffened where necessary.

4.1.3. Forced Draft Fan

One - for supplying the process air into the system. The carbon steel fan would be centrifugal type supplied complete with casing, impeller, baseframe and OSHA approved shaft guard. Excluding 50 HP motor and frequency inverter.

4.1.4. Cold Air Duct

One – approximately 5 ft. long, of carbon steel construction, connecting the forced draft fan to the natural gas fired air heater. Supplied in flanged sections and stiffened where necessary.

4.1.5. Natural Gas Fired Air Heater

One- for raising the process air to the temperature required by the dryer, up to a maximum temperature of 450°F. The Maxon NP type duct burner would be supplied complete with pre-piped and pre-wired gas train to IRI/FM standards, burner management system and local panel giving fault annunciation. The air heater casing would be fabricated in carbon steel. Nominal heat release 3.2 MMBtu/hr.

4.1.6. Hot Air Duct

One – approximately 5 ft. long, of carbon steel construction, connecting the gas fired air heater to the fluid bed. Supplied in flanged sections and stiffened where necessary.

4.1.7. Static fluid bed – 3' width by 16' long.

One – with lower air plenum, fluidizing grid, and hood, providing 36 ft^2 total drying area and 12 ft^2 cooling area. The unit would be supplied complete with the following:

a) Lower plenum in carbon steel, complete with multiple internal baffles and manual control dampers for adjustment of fluidizing velocity along the bed and sloping base for draining.
b) Fluidizing grid and upper plenum (hood) in SS316L, flanged design for grid removal.
c) Access doors with glass windows, roof-mounted lighting, feed/discharge connections in SS316L.
d) One manually adjustable discharge weir in SS316L.
e) Hinged explosion vents on upper plenum.

4.1.8. Fluid Bed Exhaust Duct

One – approximately 20 ft. long, in carbon steel construction, connecting the fluid bed air outlet to the cyclone inlet. Supplied in flanged sections and stiffened where necessary.

4.1.9. Cyclone

One – 63" diameter in carbon steel construction for separating entrained fine product from the exhaust air. Complete with air inlet, air outlet and product discharge connections.

4.1.10. One Induced Draught Fan

One - heavy duty centrifugal type, of carbon steel construction for drawing the exhaust air from the bed through the cyclone. The carbon steel fan would be centrifugal type supplied complete with casing, impeller, baseframe and OSHA approved shaft guard. Excluding 75 HP motor and frequency inverter.

4.1.11. Exhaust Duct

One – approximately 40 ft. long, in carbon steel construction, connecting the cyclone to the fan inlet. Supplied in flanged sections and stiffened where necessary.

4.1.12. Cooling Air Supply Fan

One- for supplying ambient air into the cooling section of the fluid bed. The carbon steel fan would be centrifugal type supplied complete with casing, impeller, baseframe and OSHA approved shaft guard. Excluding 25 HP motor and frequency inverter.