PASCONEXT

Pelletizing Pilot Plant

In the pelletizing pilot plant, the aim is to simulate both the pelletizing and thermal treatment process similar to the main production line of the factory. Hence factory process modifications or improvements can be simply performed. This process is thoroughly automatic and can be not only controlled but also observed from the control room. Siemens PLC S7-I500 (the newest control plc manufactured by Siemens) is used in the control system of Pasco's pelletizing pilot plant. Moreover, the instrumentations used throughout this process were selected from the highest quality and most reputable brands available in the market, and all settings, control, etc., are simply embedded in a software proportionate to that.

This product is a small-scale and full pelletizing plant designed based on Allis Chalmers method including two sections, production of green pellets and their baking. The equipment for producing green pellets include the following:

1) Mixer
2) Vibratory feeder
3) Conveyor
4) Disc
5) Rotary sieve

- **Mixer**

The concentrate powder must have a special surface of 1400 to 1800 grams per square centimeter so that an appropriate pellet can be produced from it. After preparing the concentrate, bentonite and water must be mixed in a certain ratio so that a totally homogeneous and uniform mixture is obtained. This mixture is produced in a special mixer, where both the agitator and the mixer tank rotate. In addition to device precision, producing a homogeneous mixture requires high experience so that a desirable concentrate mixture can be produced.

Mixer	
Weight	780kg
Container height	400mm
Container diameter	550mm
Occupied space	2150×700×2100 height in mm
Container motor power	1.5kw
Blade drive motor power	11kw
Rotational speed of the container	15-30 R.P.M
Rotational speed of agitator	200-1000 .M

The advantages of the mixer are as follows:

- Easy pouring of the concentrate into the mixer.
- Adding water to concentrate powder in form of powdered water particles with a well-defined volume
- Ability to adjust the rotational velocity of the mixer's tank and agitator.
- Setting the mixing time
- Complete and convenient depletion of the mixture from the mixer tank
- Easy cleaning of tank and agitator.
- Adherence to operator safety factors in face of different parts of the device.
- Automatic addition of water to mixtures in order to achieve the target moisture
- The stainless steel material of blades and tank.

- **Vibratory feeder and conveyor**

The **Vibratory** feeder and conveyor devices transfer the mixture produced in the mixer to the disc, automatically and with an adjustable speed.

The manner of pouring the concentrate into the disc must be totally homogeneous and uniform so that desirable pellets can be produced. The mixed concentrate powder is poured into the Vibratory feeder and slowly transferred onto the conveyor. After mixing, the concentrate powder is transported to the conveyor using the vibratory feeder and the conveyor inputs it to the disc with a velocity similar to that of the production line conveyor.

The advantages of conveyor include:

- Adjustable angle from conveyor to the disc

- Adjustable belt speed

- Conveyor safety issues are observed.

- Ability to control the conveyor by the operator

Feeder	
Tank capacity	100 Kg
Type of motor	Vibration motor
Motor capacity	100 Kg
Dimensions	90×90×60 cm
Conveyor	
Belt length	2 m
Belt width	20 cm
Power of motor	0.5 hp

- **Disc**

Similar to other equipment, the disc apparatus of the pilot plant also has experimental dimensions, designed and built in Paya Sanat Sama to produce low volume pellets. The disc apparatus has a diameter of 80 centimeters and a depth of 20 centimeters, so that it can provide the highest simulation of the pelletizing disc in the production line. The edges of the disc are proportionate to its diameter, and during the pelletizing process, the pellets exit through the lower edges of the disc. Several spades are embedded inside the disc to guide the mixed powder in different angles, moreover there exists a powdered water sprayer to provide the required water.

Disc	
Rotational speed	20-30 rpm
Diameter	80cm
Depth	20cm (flexible)
Type of water spraying	Powdered
Weight	350Kg
Dimensions	1×1.2×2m
First motor	2hp sew
Angular change motor	0.5hp sew

The advantages of the disc produced by Pasco company

- Adjustability of disc rotational speed

- Automatic adjustability of disc angle with respect to the horizon

- Ability to measure and display the angle using a digital protractor instantaneously

- Ability to displace the spades diagonally and deep inside the disc

- Ability to displace water sprayer inside the disc

- The disc being equipped with a high-pressure water pump with a specified flow rate

- The automatic and totally intelligent nature of the device

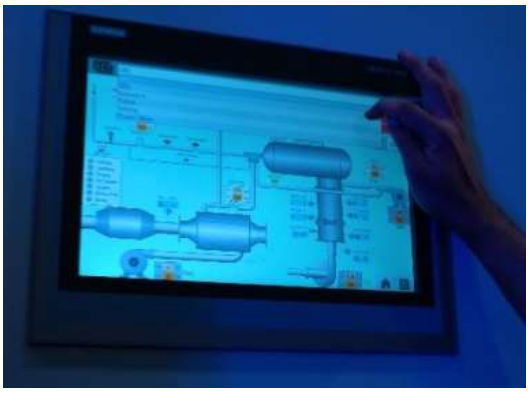
- **Rotary Sieve**

The rotary sieve device is responsible for sizing green pellets coming out of the disk, so that pellets with appropriate sizes are screened for the remainder of baking process and pellets with unusual sizes or problematic pellets are returned back to the crushing stage.

The performance of the device is such that grooves with required widths are created within a rotational drum then pellets are forced forward due to the slope of the drum and exit the grooves and fall into the buckets bellow them, according to their sizes.

Fired pellet production unit

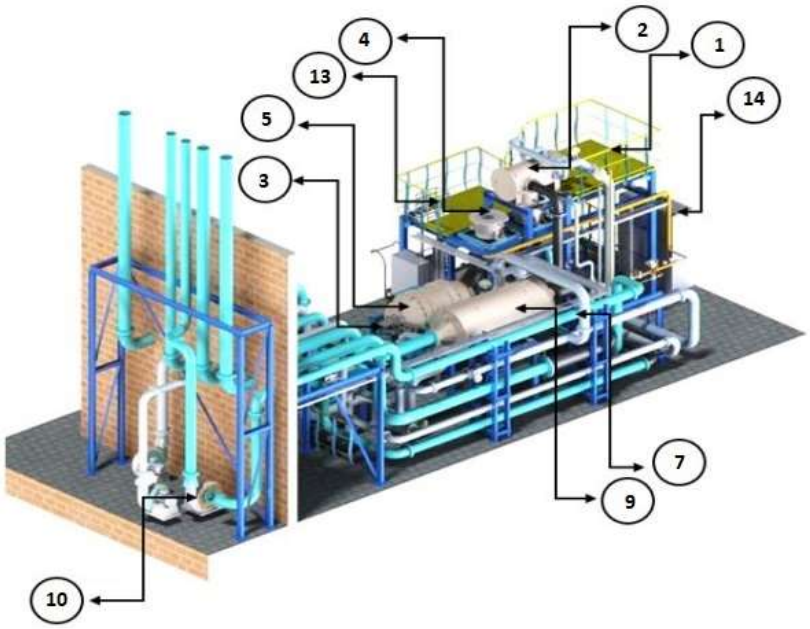
By transferring the produced green pellet to the baking pot, baking process is simulated similar to the TG (travelling grate) section of the mainline. Next, it enters the rotary kiln for complete firing, after that, it is cooled in the cooling. Then,the thermal graph, the method of pellet baking, the amount of additives, and all of the adjustments, including set points for temperature and pressure, fan speed, and the speed of rotary kiln are sent to the central system using computers, tablets, and device display, automatically.



The pilot plant consists of several sections, the 14 main parts of which are as follow:

1.Main structure
2.Combustion chamber
3.Burners
4.Preheating and baking pot
5.Rotary kiln
6.Wind box
7.Gas lines
8.Cooling system
9.Heat exchanger
10.Fans
11.Hydraulic system
12.Pneumatic system
13.Lifter
14.Electrical switchboard and instrumentations

Some of the components of the pilot plant mentioned above are illustrated in the figure below:



1.Main structure

The pilot plant is designed and constructed according to the mainline. in the Allis Chalmers method, pellets experience a specific decline after the end of the TG region and are placed in the rotary kiln, then go through a second decline into the cooling region. Therefore, a structure is designed to simulate these two declines within the production line. Moreover, in order to simplify working with the system, its settings and maintenance, appropriate platforms are prepared.

2.Combustion chamber

The combustion chamber, with a specified volume and shape, is designed such that it can increase the temperature of the pellets inside the baking pot up to sintering temperature, while remaining the closest case to the main line; to this end, in addition to gas, air, and secondary air around the burner, hot air enters the container from three different inputs. Furthermore, to control the temperature of the pellet input air, cold air is injected into the end of the container from three

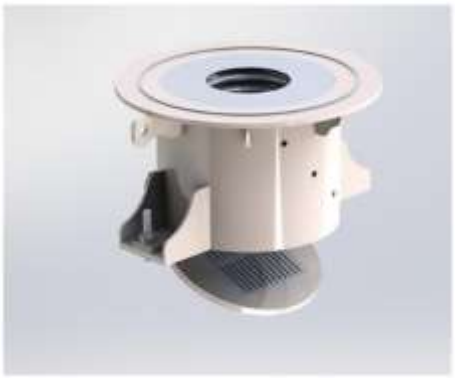
different points. Emergency exhaust is also embedded in the container design for safety reasons so that it can react in case of an excessive pressure increase. To observe the container temperature and pressure, a thermocouple and a pressure transmitter are added so that the user becomes aware of the temperature and pressure of the chamber at all times.

3.Burners

The pilot plant contains two burners, each of which has a capacity of 500 thousand kilocalories per hour. The reliability coefficient of these burners is such that it covers any type of thermal graphs from very fast to very slow. Moreover, the design is performed in a way that the burner turns on easily, smoothly and with easy usability. Additionally, to increase their lifespan, a cold air input is located at the end of the burner to prevent overheating at the outer parts.

4.Preheating and baking pots

This pot is known as the preheating pot which is for preheating the combustion chamber. After this, to perform the baking process on the green pellets poured inside the baking pot, the preheating pot is brought out from under the container and replaced by the baking pot.

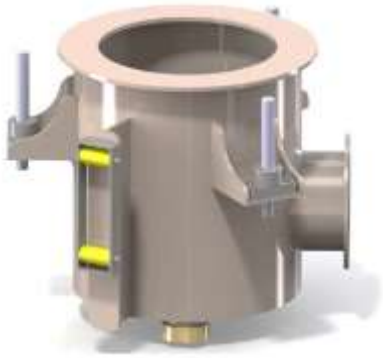


5.Rotary kiln

To simulate the firing zone, the rotary kiln is designed such that it rotates on four friction wheels with variable speeds between zero to 5 rpm. Kiln's door is locked with a Newton clamp after closure to provide higher safety. This door is opened and closed using a hydraulic jack and the limits of opening and closing are controlled using a proximity eye sensor. To empty the pellets from the kiln after baking, it is raised to an angle of about 40 degrees using two jacks embedded on the structure. The burner on the door of the kiln is connected to the main airline using three rotary joints.

6.Wind Box

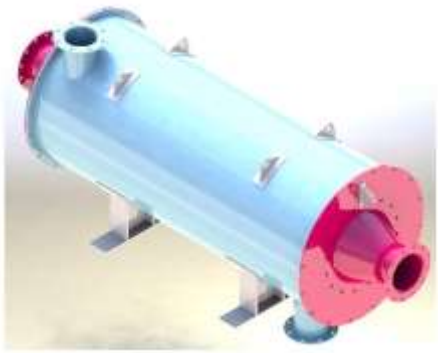
Similar to the production line in the TG region, the sub-grade bars are located in the wind box container. Moreover, the wind box in the pilot plant is responsible for raising the baking and preheating pots to seal them against leakages of the combustion products. The internal fireproofing of the wind box is superboard attached to its internal surface using Chamotte mortar. Moreover, refractory yarn is placed over the wind box surface to provide satisfactory sealing. In addition, one hydraulic jack moves the box upwards and downwards.



7.Heat exchanger

Heat exchanger is a very useful equipment in the industry that provides the ability of heat energy transfer between two or multiple fluids in different temperatures. This operation can be performed between liquid-liquid, gas-gas, or gas-liquid. it is also used to cool a warm fluid or to warm a fluid with a lower temperature, or both.

To increase the efficiency of the system, a heat exchanger is used along with a heat recovery device, using the outputs of combustion to increase the temperature of the fresh air input to the burners.



8. Gas lines

Gas lines, consist of two main gas supply lines to burners of the combustion chamber and the rotary kiln, each of which is equipped with devices required for measurement and adjustment of gas flow. First, the input flow rate is measured using a flowmeter and then passes through a regulator to adjust the pressure. Afterwards, the embedded pressure transmitter measures and transfers the pressure. The push type and gradual control and solenoid valves also exist in the remainder of the path. Moreover, two manual and electrical vent paths are also considered that exit the system after being merged.

9. Cooling pot

To perform the cooling process the pellets within the kiln are poured inside a pot. This pot, which is also known as the cooling pot, is moved by a motor rotating a

screw. There exist thermocouples within this pot in order to control the temperature. It is possible in this pot to cool the pellets using cold air or warm them with hot air or both. The required air is injected on the pellets from below the cooling pot and then exits through the pipe over them. The horizontal movement of the cooling pot is controlled with proximity sensors.

10. Fans

To supply the air required for the combustion of the burners and to output, the combustion products from the wind box, one suction fan, and two blower fans are provided. The bigger blower fan supplies the air entering the heat exchanger and the smaller one is used for cooling operations and controlling the temperature at the combustion chamber.

11. Hydraulic and pneumatic systems

A hydraulic system is used to raise or lower the wind box and to displace the baking and preheating pots under the combustion chamber and to move the rotary kiln in horizontal and vertical directions and open and close the door of it. The movement courses of the kiln, pot, and wind box are controlled using a proximity sensor. A pneumatic system is used to open and close the emergency line valves, to open the door of the baking pot for discharging the pellets inside the rotary kiln (1st discharge), to open the door of the cooling pot for final discharge and for vertical movement of the cooling wind box.