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ABSTRACT

The invention relates to a Spray Fluid Bed Cooler consists of cooling chamber (1) having a fluid bed (2) at bottom. A Cyclone separator (3) provided to the air out let at top of the chamber. An air circulation blower (4) through Air cooler (5) connected to first air inlet in the fluid bed bottom Fluid Bed air distribution plate (6)and a bottom air jet(7)located in the fluid bed centre. A second air inlet at top air jet (8); a perforated plate (10) provided at top for taking out air from cooling chamber. A spray nozzle for hot liquid spraying provided at top centre of cooling chamber so as to produce spray surrounded by jet of cold air which has path concurrent with sprayed liquid where as air from fluid bed and bottom air jet flows in counter current with sprayed liquid; a hot water jacketed. A feed tank (11) for hot liquid provided with feed pumps (12). The feed pipeline from the feed tank out let to the said spray nozzle jacketed for hot water circulation. The control means for the air velocities in the cooling chamber (1) and fluid bed (2) to be maintained in such a way that particles of desired size only fall down on fluid bed (2) while all fines are carried over with air. A weir pipe (17) at bottom centre of fluid bed with rotary valve (14) at out let for discharging cooled granules. The bottom outlet of said cyclone joined to the pipe leading to the second air inlet.

REFERENCE FIGURE 1

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WE CLAIM:-

1. A Spray Fluid Bed Cooler consist of cooling chamber (1) having a fluid bed at bottom(2); a Cyclone separator (3)provided to the air out let at top of the chamber; an air circulation blower (4) through Air cooler (5) connected to first air inlet in the fluid bed (2)bottom Fluid Bed air distribution plate (6) and a bottom air jet (7) located in the fluid bed centre; a second air inlet at top air jet (8);a perforated plate provided at top for taking out air from cooling chamber; a spray nozzle, for hot liquid spraying ,provided at top centre of cooling chamber so as to produce spray surrounded by jet of cold air which has path concurrent with sprayed liquid whereas air from fluid bed and bottom air jet flows in counter current with sprayed liquid; a hot water jacketed; feed tank (11) for hot liquid provided with feed pumps (12); the feed pipeline from the feed tank out let to the said spray nozzle jacketed for hot water circulation; the control means for the air velocities in the cooling chamber (1) and fluid bed (2) to be maintained in such a way that particles of desired size only fall down on fluid bed (2) while all fines are carried over with air; a weir pipe (17) at bottom centre of fluid bed with rotary valve (14) at out let for discharging cooled granules; the bottom outlet of said cyclone joined to the pipe leading to the second air inlet.

2. The spray fluid bed cooler as claimed in claim 1 wherein Cooling air inlet pipe to first inlet provided with damper and pipe size selection of cooling air inlet pipe to the said second inlet so as to control the air enters in the cooling chamber from the said fluid bed bottom Fluid Bed air distribution plate typically 30% , a bottom air jet typically 40% and top air jet typically 30%.

3. The spray fluid bed cooler as claimed in claims 1 to 2 wherein the said cooling chamber installed on the bagging plant to enable direct bagging of granules from the rotary valve outlet.

4. The spray fluid bed cooler as claimed in claims 1 to 3 wherein separate inclined screw conveyer employed to discharge the powder at desired height.

5. The spray fluid bed cooler as claimed in claims 1 to 4 wherein the said air velocity control means by instrumentation (16) consisting of Diff pressure transmitter, PID controller and VFD for air circulation blower (4) Motor. This loop enables the constant air circulation rate in the cooler.

6. The spray fluid bed cooler as claimed in claims 1 to 5 wherein the said air cooler cooled by brine.

7. The spray fluid bed cooler as claimed in claims 1 to 6wherein the said feed pipe to nozzle is provided with a bypass pipe control valve connected back to the said feed tank to control the fluid flow to nozzle.

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FIELD OF INVENTION:-

The present invention relates to improved and compact type of vertical spray cooler. This new configuration of spray cooler can agglomerate the granules to generate the desired coarse particle size. This is a compact spray fluid bed cooler which can be assembled in factory and can be installed quickly on site. This configuration requires no special structural / civil building.

PRIOR ART:-

A. Vertical configuration

Conventional spray cooler consist of vertical Spray Cooling chamber, Air cooler, Air circulation fan and cyclone separator. In this configuration cooling chamber is installed vertically and liquid is sprayed either from top to bottom or from bottom like fountain.

B. Box type spray cooler with multiple spray nozzle and fluid bed at bottom

This is box type cooling chamber having fluidised bed at bottom and consisting of cooling chamber, bag filter, finned tube air cooler and air circulation blower. Liquid is sprayed using multiple jet atomization nozzles.

NEED FOR INVENTION:-

The configurations described in prior art has several shortcomings.

A. Vertical configuration

1. Wide range of particle size distribution
2. No in built provision for segregation of particles below desired size
3. Vertical installation makes the plant tall, which cannot be accommodated in a standard industrial building.
4. Heavy structure and tall building required due to installation at higher levels
5. Vital equipments in Spray cooler like Air blower, Spray Nozzle, Air cooler are located on Top floor. To inspect and maintain these equipments, the operator is periodically required to climb up on the top floor.
6. Special structural building required for housing the Spray cooler plant
7. High initial cost of the building

8. Manufacturing of cooling chamber of large diameter is long critical process It involves following activities:
    a) Fabrication of large chamber in the workshop
    b) Cutting of shell in to sectors to suit containerised shipment
    c) Re-assembly and welding of sectors at site to form the chamber

    To avoid the cutting and re-assembly, it is possible to transport the Cooling Chamber in one piece. However the cost of packing or crating, safe handling and transportation is prohibitively high.
9. The manufacturing process for cooling chamber required highly skilled and experienced manpower due to use of thin metal sheets for construction of chamber and other components. This increases the cost of fabrication and site installation substantially.
10. The total investment required for the Spray Cooler is very high.

B. Box type spray cooler with multiple spray nozzle and fluid bed at bottom

1. Multiple spray nozzles of very fine orifice diameter leads possibility of frequent nozzle choking
2. Identification and replacement of chocked spray nozzle is tedious and time consuming task
3. Very fine orifice diameter make system vey much dependent on filters and cleaning of filters is regular maintenance activity
4. Slight damage / choking of spray nozzle disturb the spray pattern. Any deflection of liquid jet from its path may result in striking of jet on walls.
5. High Possibility of striking un-atomized liquid on fluidised bed. This leads to choking of fluid bed and frequent cleaning is required.
6. Bag Filter is mandatory to avoid fines carryover to finned tube air cooler. For materials like palm stearine / wax / Stearic acid which are stick and oily, Bagsget chocked frequently and need to be cleaned at regular interval
7. Finned tube air cooler gets chocked with fines from the cooling chamber
8. Deposition of fines on finned tubes causes fouling and effectiveness of heat exchanger decreases. This causes increase in cooling air temperature and hence reduction in plant capacity.

OBJECTIVE OF INVENTION:-

It is an object of invention to provide a Spray fluid bed cooling plant to be installed in standard factory building that will not required specialised structural / civil work by reducing the height of spray cooler and thus reducing the initial cost of building structure.

It is an object of invention to provide a Spray fluid bed Cooler more operator friendly by locating the components like air fans, spray nozzle, air cooler etc. at ground level. It is also an object invention to provide a spray fluid bed cooler to generate desired particle size precisely with the help of agglomeration process and to minimise the proportion of fines in to product.

It is also an object of invention to provide a spray fluid bed cooler:-

- to make equipment capable of manufacturing wide range of particle size; to make equipment capable of operating on single spray nozzle;
- Reducing / eliminating the equipment dependency of incoming filter
- Equipment to be operation friendly and less maintenance prone
- To avoid the need of Bag filter in spray cooler
- To avoid use of finned tube air cooler
- To make equipment capable of giving consistent output throughout thee operating period.

STATEMENT OF INVENTION :-

Accordingly the invention provides a Spray Fluid Bed Cooler consist of cooling chamber (1) having a fluid bed (2) at bottom; a Cyclone separator (3)provided to the air out let at top of the chamber; an air circulation blower (4) through Air cooler (5) connected to first air inlet in the fluid bed bottom Fluid Bed air distribution plate (6) and a bottom air jet (7) located in the fluid bed centre; a second air inlet at top air jet(8); a perforated plate provided at top for taking out air from cooling chamber; a spray nozzle, for hot liquid spraying ,provided at top centre of cooling chamber so as to produce spray surrounded by jet of cold air which has path concurrent with

sprayed liquid whereas air from fluid bed (2)and bottom air jet(7) flows in counter current with sprayed liquid; a hot water jacketed; feed tank (11) for hot liquid provided with feed pumps (12); the feed pipeline from the feed tank out let to the said spray nozzle jacketed for hot water circulation; the control means for the air velocities in the cooling chamber (1) and fluid bed (2) to be maintained in such a way that particles of desired size only fall down on fluid bed (2) while all fines are carried over with air; a weir pipe(17) at bottom centre of fluid bed with rotary valve (14) at out let for discharging cooled granules; the bottom outlet of said cyclone joined to the pipe leading to the second air inlet.

DESCRIPTION OF FIGURES:-

The invention is described with reference to the figure of accompanying drawing wherein;

Fig. 1: Shows the process and instrument diagram for the system in present invention.

DESCRIPTION OF INVENTION:-

Referring to figure 1, the Spray Fluid Bed Cooler consist of cooling chamber (1) which has fluid bed (2) at bottom(2).Cyclone separator (3), Air circulation blower (4), Air cooler (5) are at same location in process as in conventional spray cooler.

Cooling air enters in the cooling chamber from 3 locations

a. Bottom Fluid Bed air distribution plate (6) – Typically 30%;
b. Bottom air jet (7) – Typically 40%;
c. Top air jet (8) – Typically 30%.

Air from bottom air jet can be adjusted by modulating damper (9).Air is taken out of cooling chamber (1) from top perforated plate (10).The hot liquid is sprayed from top. The spray is surrounded by jet of cold air which has path concurrent with sprayed liquid. Whereas air from fluid bed and bottom air jet flows in counter current with sprayed liquid. The feed tank (11), feed pumps (12) and the feed pipeline (13) for hot liquid are jacketed for hot water circulation. Hot liquid droplets are cooled and solidify when comes in contact with jet of cold air and fall down on fluidised bed (2) at the bottom of chamber (1).From the fluidised bed (2) fine particles are carried over with

air and only coarse particles remains in fluid bed (2).The air velocities in the cooling chamber (1) and fluid bed (2) are maintained in such a way that particles of desired size only fall down on fluid bed (2) while all fines are carried over with air. Cooled granules in fluid bed (2) overflow in the weir pipe (17) and discharged from Rotary valve (14). Cooled powder can be bagged directly below rotary valve (14), if the building height permits installation of cooling chamber (1) above bagging plant or separate inclined screw conveyer can be employed to discharge the powder at desired height. Jet of cold air from bottom penetrates in to the spray cone and hence all particles come in contact with cold air this enables better cooling of entire sprayed liquid and use of Solid cone nozzle (15). Fines carried over from fluid bed (2) comes in contact with sprayed liquid and agglomerates with them. Fines generated in spray get carried over with air and get separated in cyclone Separator (3).These fines are re circulated in cooling chamber (1) using cold air from air circulation blower (4). Hot air from cyclone separator (3) is re circulated in cooling chamber (1) by air circulation blower (4). Before entering the cooling chamber (1) air is cooled in air cooler (5) by brine Air flow is measured online and controlled by instrumentation (16) consisting of Diff pressure transmitter, PID controller and VFD for air circulation blower (4) Motor. This loop enables the constant air circulation rate in the cooler.

Amodulating damper provided in the said first inlet pipe or adjusting bottom air jet. The said feed pipe to nozzle is provided with a bypass pipe control valve connected back to the said feed tank to control the fluid flow to nozzle.

ADVANTAGES OF PRESENT INVENTION:-

1. Wide range of particle sizes can be generated in same equipment.
2. Particle size can be controlled easily by changing nozzle or distance of Spray nozzle from fluid bed and residence time of granules in fluid bed.
3. Fines are re circulated in for agglomeration hence No fines in the product.
4. Single nozzle system hence ease for maintenance and replacement
5. Due to compact design the plant can be fitted in standard factory shed.
6. No specially designed structural or civil building required for installation.
7. Savings in initial investment as no specially designed structure is required

8. Project can be completed in short duration
9. Simple manufacturing process compared to conventional vertical spray cooler. This saves time and cost of manufacturing
10. Entire cooler can be assembled in factory. Hence site work is minimized.
11. Vital components like Air Blower, Feed Pump are located on ground level hence maintenance of the same is easy.

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2. The spray fluid bed cooler as claimed in claim 1 wherein Cooling air inlet pipe to first inlet provided with damper and pipe size selection of cooling air inlet pipe to the said second inlet so as to control the air enters in the cooling chamber from the said fluid bed bottom Fluid Bed air distribution plate typically 30% , a bottom air jet typically 40% and top air jet typically 30%.

3. The spray fluid bed cooler as claimed in claims 1 to 2 wherein the said cooling chamber installed on the bagging plant to enable direct bagging of granules from the rotary valve outlet.

4. The spray fluid bed cooler as claimed in claims 1 to 3 wherein separate inclined screw conveyer employed to discharge the powder at desired height.

5. The spray fluid bed cooler as claimed in claims 1 to 4 wherein the said air velocity control means by instrumentation (16) consisting of Diff pressure transmitter, PID controller and VFD for air circulation blower (4) Motor. This loop enables the constant air circulation rate in the cooler.

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