ATFER

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CHANGE OF THE FILTRATION CIRCUIT

1-Objective

Most of the phosphoric acid units include a conventional filtration section with a filter,usually BIRD,a primary and a secondary vacuum pumps,filtrate receivers,an agitated seal tank with submerged or sometimes horizontal pumps,a network of piping with associated valves and fitting,instrumentation for controling the level of the seal tank and the transfer of filtrates.The filter is installed at high elevation (50' or 15 m).The filtration circuit is usually washed every week during a shutdown of 8 hours which often requires an additional labour force for mechanical cleaning.

The new filtration section which is proposed is extremely simple and clearly showned on the attached sketch.All ancillary equipments are removed at the exception of the primary vacuum pump and the associated acid trap and scrubber.Only a few new equipments have to be procured : one central valve with the gas release at the top,and one,two or three horizontal filtrate pumps according to the layout of the unit.

The new filtration circuit can be installed within a shutdown of a couple of days.

The benefits can repay the expenditure very shortly,sometimes in a few months.

2-Description of the new central valve

The gases and the filtrates coming from the filter pans are separated inside the stationary part of the central valve : the gases are released at the top cone while the filtrates are flowing downward by gravity in the relevant port.Each port is directly connected to the suction of a horizontal filtrate pump.

The ports are separated by dampers which can be inclined from outside during normal operation in order to adjust at any time the length of each port to any change of filter feed or filtration rate.

An additional side nozzle is used as an overflow in order to flood the stationary part of the central valve during the periodical washings of the filtration circuit.

The three bridges separating the vacuum from the atmospheric air are independent one from each other in order to adjust separately and accurately each of them.They are made of high density polyethylene and are short enough to increase the effective surface of the filter as well as the length of the dry cell.

The wear rings on the stationary part are bolted and made of 20-25-4 stainless steel (Uranus B6,904L etc...),as well as all the metal parts of the central valve in contact with acid or gases.The gasket bolted on the rotating part is made of high density polyethylene and does not require any lubrication.Its expected life is five years.

Three small polyethylene blocks are bolted and adjustable on the stationary cone of the central valve for centering the rotating part.They slide against the inner side of a cylinder welded on the rotating part.

The pushing device of the rotating part is similar to the existing one.

Two holes on the rotating part are used to insert hooks to lift it.Oil jacks can also been installed.The rotating part can be raised by 6 to 7 inches without any dismantling.

In order to keep into service the central lubrication of the filter,the grease pump must be installed on the rotating frame of the filter and energized with rings and trolleys.

The tensioning antirotation rods,if any,are not anymore necessary.

The nozzles on the rotating part are exactly in the same location as before in order to use the existing hoses.

The stationary part is bolted on the pedestal which has to be shortened because the height of the central valve is increased.

3-Description of the gas circuit

The top of the stationary part is connected to the gas duct going overhead the filter and connected to the existing acid trap. Keeping two separate vacuum circuit does not bring any significant benefit and therefore is not used anymore.On all the modified filters,only the primary vacuum pump has been kept into service with,most of the time,a rise of vacuum.The flowrate requirement at the pump suction for maintaining a vacuum of 16 to 18" Hg is 3.3 cfm per ft^2 of effective surface (60 m3/h per m^2),which is generally available on the primary vacuum pump of the existing units.A vacuum higher than 18" has no significant influence on the performance of the filter, and could even be detrimental in several ways at values higher than 20".

4-Description of the filtration circuit

The horizontal filtrate pumps are designed for the purpose of a satisfactory operation when connected to short tail legs :

-They are self regulating thanks to a flat flowrate/TDH diagram.A large range of flowrates is possible within a short variation of liquid height in the suction pipe.As a matter of fact,the pumps can operate steadily when located at a distance as short as 10' (3 m) below the central valve.Generally,the closest floor is at 13' below that valve.

The pumps are driven by pulleys and belts,which give an additional possility to increase the range of operation.

-The pumps are designed with a low required NPSH,which means they can deliver very low flowrates steadily and without cavitation.

-The pumps impellers are fitted with back blades in such a way that a sligth negative pressure is applied on the seal when the pumps are rotating,thus preventing any leak even if the packing is loose.

-The seal is a stuffing box with a standard packing.A small grease pressure is applied by means of a spring box or a centralised lubrication network both for lubricating and avoiding leaks when the pump is stopped.There is therefore no acid dilution as it occurs when the seal is lubricated with water.

-The pumps are fitted with a jacket for water cooling if there is a need for.However,no cooling is necessary if the liquid temperature is lower than 160°F (70°C),which is usual in dihydrate route.

-The material of the pumps is ferrite (chromium cast iron with molybdene),which is an alloy highly resistant to abrasion as well as corrosion.

-A backstop bearing fitted at the end of the shafts prevents the pumps against any accidental back rotation.

The strong acid port is connected to the suction of the product acid pump which discharges straight to the storage tank.If that tank is close enough to the filter and at least at 15' below the central valve,the product acid tail leg can seal in the tank without using a pump.

The medium acid port is connected to the suction of the recycled acid pump which discharges to the reactor.If the reactor is close enough to the filter and at least at 20' below the central valve, the recycled acid tail pipe can go straight to the reactor without using a pump.

The cloudy port and the drain of the acid trap are connected to the suction pipe of the recycled acid pump .

The weak acid port is connected to the suction of the weak acid pump which discharges in the weak acid wash box of the filter.

Sampling nozzles are installed at the most convenient location at the discharge of each pump,generally just above the pumps.

The miscellaneous drains coming from the blow and dry cells as well as possible leaks from the filter and from the pumps are collected in a small pot which overflows to the reactor.

5-Operation of the filtration circuit

In normal operation :

-The damper between the cloudy and the strong acid ports is adjusted in order to keep the solid content of the slurry at its target value.There is no need of an external recycling of product acid.Because a maximum amount of acid is collected from the cloudy port,the dilution of the product acid is therefore decreased.

-The damper between the strong acid and the medium acid ports is adjusted in order to collect a maximum amount of product acid in the strong acid port,thus increasing the efficiency of the cloudy port.

-The damper between the medium acid and the weak acid ports is adjusted in order to recycle an amount of weak acid compatible to the filtration rate.Only the weakest part of the weak acid is recycled to the filter,which is better than discarding part of the weak acid mixed in a seal tank.If more weak acid than allowed by the extreme forward position of the damper has to be collected in the medium acid port,the operator has to throttle a valve at the pump discharge.The acid in excess will overflow over the damper to the medium acid port.

-Adjusting the dampers and the valve should be made in conjunction with the displacement of the wash boxes,which has to be improved in most of the filters.

6-Washing the filtration circuit

When the filter has to be shutdown,even for a few minutes,the following procedure is applied :

-To stop the slurry on the filter.

-A few minutes later (exact timing is a matter of experience),to close the valve at the discharge of the recycled acid pump to the reactor and to open the valve on the return line to the slurry box of the filter (or to the suction of the slurry pump).

-At the same time,to swap the circuit on the product acid line from the storage tank to the drain.

-At the same time,to throttle the valve on the product acid tail leg in such a way that the central valve fills up to the overflow nozzle,thus keeping that central valve flooded and ensuring a maximum flow to the pumps.

Nota : Depending on the local configuration of the unit,the return line can be at the product acid pump discharge and the drain at the recycled acid line.

To restart the filter,to reverse the hereabove procedure.

7-Expected benefits

The benefits expected from the new filtration circuit are :

-A better control of the operation and therefore increased performances of the unit because the samples of acids are not affected by any retention time and blending effect in a seal tank.

-An increased capacity and a higher P2O5 efficiency of the filter because the flowrate and strength of the weak acid can be optimized at any time.

-Generally an increase of 5 to 8 % of the effective surface of the filter.

-Less dilution water and solids in the product acid thanks to the increased length of the cloudy port.

-No P2O5 losses neither acid dilution when washing the filter.

-Periodical washings of the filter are more frequent and more efficient with less down time.Indeed,every planned or accidental shutdown of the filter is used for washing as part of the normal shutdown procedure and without any dead time.On the other hand,the surface of equipment and piping to be washed is considerably reduced.Therefore the whole filtration circuit,including the filter cloths and the bottom of the cells,are always in a cleaner state without a need for periodical planned washing.

As a consequence,the on-stream time is increased.

-Maintenance on the seal tank and other vessels,on the pumps,the agitators,piping,fitting,instrumentation,central valve and secondary vacuum pump is considerably reduced.Horizontal pumps have less corrosion than submerged pumps because they are corroded on only the inner side and because their temperature is lower.

-Manpower requirement is decreased both for operation and cleaning.

-Electricity consumption is lower.Typically,it is 7 amps (440 v) on each product and weak acid pumps of a 24C BIRD filter.

8-Expenditure

The new equipment,central valve and pumps,have to be imported from France because they are of special technology developed by two French manufacturers.

Investment cost is ranging from 150,000 $ to 450,000 $ according to the size of the filter,the number of pumps,the flowdiagram and the scope of engineering.

9-Implementation

The delivery time for the new equipment is normally 4 to 5 months.As a matter of fact,several units have been started up 4 months after placing the orders.

If the pumps are installed and the pipes prefabricated and flanged in advance,the loss of production for modifying the filtration circuit can be reduced to a couple of days.

10-References

4 units have been modified :

-ARCADIAN,Louisiana,U.S.A. in January 1988
Filter : BIRD 24C
Rock : Bucraa

-AMP,Ambarnath,India in August 1988
Filter : BIRD 12B
Rock : Jordan

-NU-SOUTH,Mississipi,U.S.A. in January 1989.
Filter : Bird 24C
Rock : Morocco

-IMC,Florida,U.S.A. in February 1989
Filter : Bird 30D
Rock : Florida

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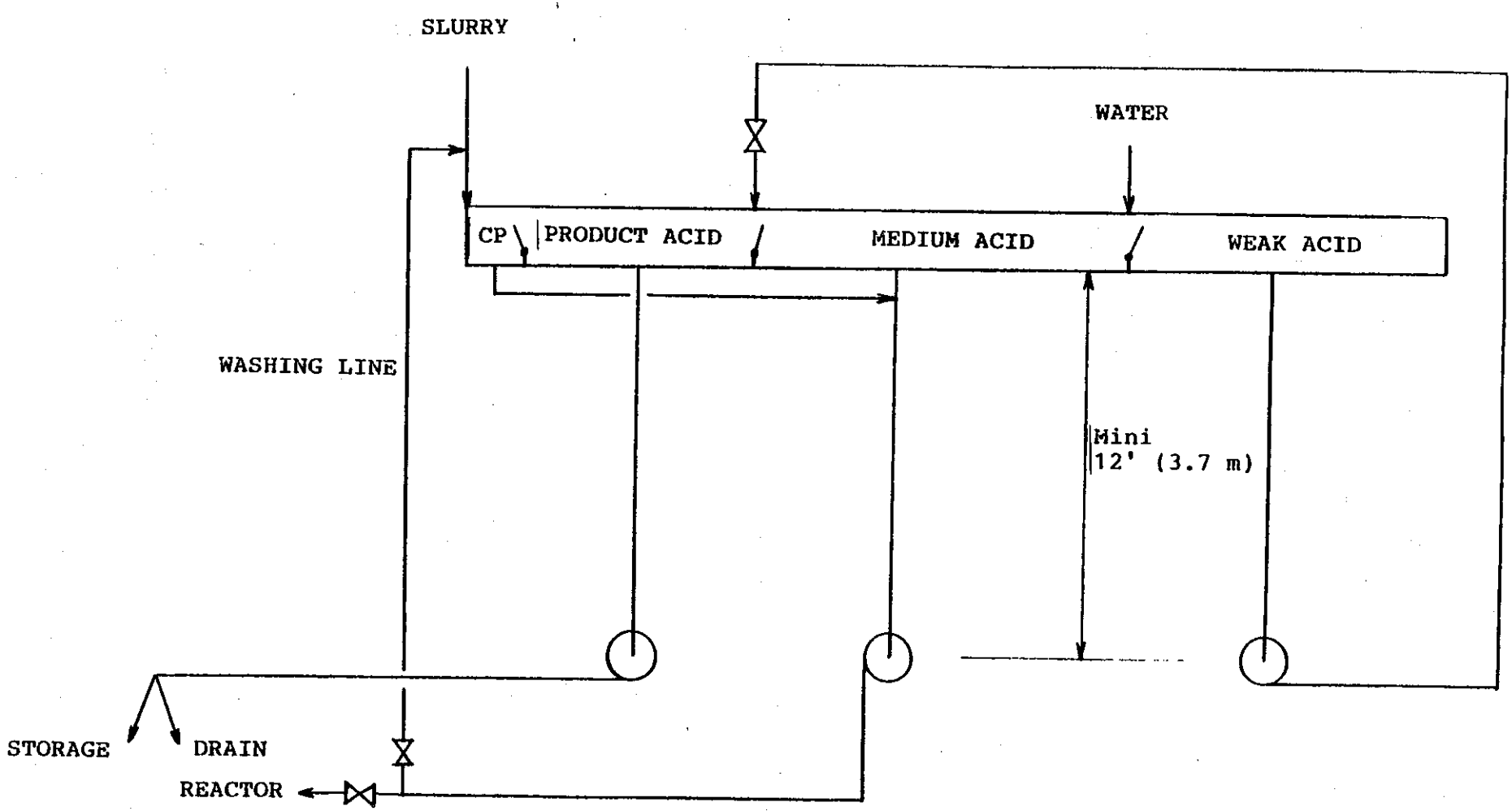
FILTRATION CIRCUIT



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