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PROMATIC FILTER SYSTEM is an automatic Feed filter specifically designed to remove continuously oversize solids, catalyst and iron sulphide particles, coke fines and various different contaminants from "feedstocks".
It is applied primarily for clarification of Heavy oils, Slurry oils, Heavy fuels, Amine solutions, solutions of chemical products, Condensates when only a small quantity of product can be sent to waste or for recovering of subproducts.

PROMATIC FILTER SYSTEM, by separating catalyst fines, coke and solid particles from oil products, Amine solutions and other different liquid solutions allow to reach high performance and to maintain optimum reaction parameters.
The schematic design is based on more FILTER STATIONS mounted in parallel and started in filtration at the same time except one that is maintained as Spare for when the Cleaning cycle will start. To obtain the maximum flexibility in operation, to make the operation of cleaning and regeneration faster and to reduce the amount of gas necessary for "gas assisted backwashing" , the size of the Filter vessels are maintained within a certain diameter to reduce the volume of product, charged with all contaminant retained, delivered to waste.
All the FILTER VESSELS have installed the same number of Metallic filtering element to have a good distribution of flow during filtration phase.
The FILTER VESSELS are connected to INLET and OUTLET HEADERS, to a main Discharge drum positioned below the filter vessels and to a Top drum containing the gas used for pressurize during cleaning – backwashing cycle.
The FILTER SYSTEM is designed and equipped for Full automatic operation, controlled by PLC or DCS, to allow easy management even in remote areas, high filtration rates and real savings in operative costs.

Summarizing the **BENEFIT of BEA Technologies design for PROMATIC**:

1) Multiple FILTER VESSELS connected in parallel provide **higher flexibility in operation** for easier management of sudden increase of contaminant load.

2) Multiple FILTER VESSELS connected in parallel provide **better flow distribution** for higher retention capacity.

3) Multiple FILTER VESSELS connected in parallel , due to small volume of each single vessel, provide **faster cleaning cycles** and reduced amount of product load with contaminants delivered to waste.

4) Multiple FILTER VESSELS connected in parallel provide **easier management** due to automation and higher reliability of the system because less sensititive to flow increase in case one filter vessel should be set out OFF-LINE **for maintenance requirement** (as replacement of a gasket on a valve) .

FIGURE 1: FILTER BANK PART OF THE SYSTEM BASED ON NR 3 BANKS .

DESCRIPTION OF A TYPICAL OPERATION SCHEME.

PROMATIC is a modular system composed by one or more fully assembled skid mounted units called BANKS.
A bank consists of a number of Filter housings connected in parallel to common HEADERS:

- INLET HEADER
- OUTLET HEADER
- DRAIN HEADER
- GAS ASSISTED BACKWASHING HEADER
- EXTERNAL STEAM or LIQUID SOAKING LINE

Each housings contains a specific number of STEELPORE filter cartridges, at controlled filtration rating, designed to remove the specific contaminants and to be easily regenerated by backwashing.

In a bank all filter housings are located on one side of the unit while the drum containing the nitrogen and the drum to collect the liquid used for backwashing are on the opposite side for easier inspection and maintenance

AUTOMATIC BACKWASHING

The backwashing cycle of filter elements is initiated in a fully automated mode by the PROGRAMMED CONTROL PANEL when a preset differential pressure level is detected between inlet and outlet headers.
The differential pressure increase across the headers is caused by solid contaminants and micro-colloids, which

build-up on the filter surface thus reducing the effective open area. At a preset level, the differential pressure switch sends a signal to a solenoid valve which activates the logic of control panel.

According to a PROGRAMMED SEQUENCE compressed air is then supplied to the valve actuators of one filter

housings (module).
Feedstock to the Filter housings is shut-off while a portion of filtered liquid in the top of the housing is sent back to the line to prepare the remaining liquid for gas pressurization. The valve connecting the filter housing to the

Nitrogen pressure vessel is opened and the Filter housing is pressurized instantaneously. When the discharge valve at the bottom of the housing is opened the Nitrogen in the dome of the Filter housing is expanding instantaneously strongly pushing, in 1 sec., the remaining filtered liquid in reverse flow through the filter elements.
During backwashing contaminants are displaced from the external surface of STEELPORE cartridges with full efficiency due to maximum liquid velocity and impact force.
To accomplish this effect no more than one Filter housings is off-stream at any time. After the backwash cycle is completed the filter elements are essentially restored to their original operating condition and the control panel returns to the reset point, to start a new backwashing cycle when required.
When high flow rate and critical process conditions are present, a system composed by MULTIPLE BANKS with single control panels connected to a master main board is required. In this mode only one start signal cycles from bank to bank to prevent multiple concurrent operations of backwashing.
PROMATIC SYSTEM automatically adjusts the frequency of backwash cycles to variations of contaminant content in feed.
When HIGH CONTAMINAT LIQUIDS are fed, such as during modification of raw oil or process upsets, the intervals between backwash cycles are shortened to maintain filtered flow rate.
Fully automated operation allows the location in remote plant areas with no need of operating personnel.
In place FAIL-SAFE DESIGN include single-act valve actuators. If compressed air feed stops during backwashing all valves return to close position to avoid leakage of any fluid..
This solution prevents filtered product loss to the drainage system and gives assurance of operation according safe procedures.

BACKWASHING WITH INTERNAL LIQUID

In this option filtered process liquid is used to remove the contaminants from the outer surface of filter elements. At starting of backwash, feed and filtered product valves are closed and the valve to connect to the main GAS pressurized vessel is opened.
When the Discharge valve is opened a minimum quantity of filtered liquid, which is now at higher pressure, flows in reverse through the filter elements carrying contaminants from the housing to the vessel for collection of back-washing liquid.
As backwash cycle stops the flow returns to filtration mode.

BACKWASHING WITH EXTERNAL LIQUID

When only the small quantity of raw feedstock contained in housings is allowed in the backwash effluent or minimal loss of filtered liquid is admitted, an external liquid for backwashing is used.
In this mode a separate header for the external liquid is required.
At starting of backwash the feed and filtered valves are closed, the filter housing is drained and an external liquid is allowed to fill up the housing volume. Following the external liquid is pressurized with nitrogen and discharge valve is opened.
The pressurized external liquid flows in reverse through the filter elements carrying the contaminants to the vessel for collection of back-washing liquid.

SCHEMATIC FILTER OPERATION:

1) NORMAL OPERATION

***Note #1**: In BEA filtration system all filter housings are contemporarily in filtration mode and not as showed inside customer p&id (where two filter housings are in operation and one filter housing is in stand-by). Nevertheless BEA automatic backwashing system is sized so that when one filter housings is in backwash mode the remaining filter housings are able to face the design flow.*

During normal operation all the fuel gas tanks are full with fuel gas at the pressure regulated by the PCV (pressure control valve). Inlet and outlet valves for each filter housing are open while backwash discharge valves and fuel gas inlet valves are closed.
The position of automatic valves during filtration phase will be as below:

OPERATION	SINGLE BANK WITH THREE FILTER HOUSINGS

AUTOMATIC VALVES	POSITION (O: OPEN; C: CLOSED).
VP1	A
VP2	A
VP3	A
VP4	A
VP5	A
VP6	A
VPF0	C
VPF1	C
VPF2	C
VPF3	C
VPF4	C
VPF5	C
VPF6	C
VPB1	C
VPB2	C
VPB3	C
VPSD	C
VPBD	C

2) BACKWASH

***Note #2**: in our filter system the backwash is different from the philosophy showed inside customer p&id. In our system the fuel gas is used to push the liquid present inside the filter housing to discharge the solid cake accumulated of filter elements surface (gas is used to push liquid and discharge the solid particles). Inside customer p&id the filter housing is discharged first and then, without any liquid inside,*

the fuel gas is used to discharge solid particles. Each filter housing has a dedicated PDT (pressure differential transmitter).

***Note #3**: Fuel gas storage tanks are sized to contain a volume equal to the volume of filter elements, under the flange.*
***Note #4**: the backwash receiver is sized to accumulate two subsequent backwash of all the filter housings with a margin of 30% (because the backwash receiver must be discharged when it is full at around 70-75%).*

Considering the backwash of filter housing F1 we will have following sequence:
VP2 is closed;
VP1 is closed;
VPF2 is opened;
VPB1 is opened.

After the established time
VPB1 is closed;
VPF2 is closed.
At this point we restore the liquid inside the housing F1 to avoid pressure variations during re-start.
The valve VP1 is open and stay open up to the achievement of pressure set point of PT of the filter station (VP 2 still remain closed). When the set point is reached the valve VP" is opened and the filter station is restored in filtration mode
The gas pressure then is restored in the reservoir S1 ready for the further back wash.

***Note #5**: the check of dirty backwash fluid level inside the backwash receiver is done after the filter housing F1 is put in operation. If the level inside backwash receiver overcomes the maximum level, then:*
The valve VPF0 is opened (to use the boost of fuel gas to discharge dirty backwash fluid);
The valve VPSD (or the valve VPSD) is opened, according to the discharge philosophy of customer.

After dirty backwash fluid discharge:
VPSD (or VPBD) valve is closed;
VPF0 valve will stay open up to the achievement of the pressure established inside the backwash receiver by the PT (pressure transmitter).

Similarly will be backwashed filter housings #F2 and #F3.

The position of automatic valves during backwash phase of housing F1 will be as below:

BACKWASH OF HOUSING #1	SINGLE BANK WITH THREE FILTER HOUSINGS

AUTOMATIC PANEL	POSITION (O: OPEN; C: CLOSED).	NOTES
VP1	C	Then it opens to restore the liquid inside filer housing F1.
VP2	C	-
VP3	A	-
VP4	A	-
VP5	A	-
VP6	A	-
VPF0	C	This valve is opened after the backwash if it is necessary to discharge dirty backwash fluid.
VPF1	C	This valve is opened after backwash to restore the pressure inside S1 tank.
VPF2	A	Will be closed at the end of backwash.
VPF3	C	-
VPF4	C	-
VPF5	C	-
VPF6	C	-
VPB1	A	Will be closed at the end of backwash.
VPB2	C	-
VPB3	C	-
VPSD	C	This valve can be opened at the end of backwash if it is necessary to discharge the dirty backwash fluid.
VPBD	C	This valve can be opened at the end of backwash if it is necessary to discharge the dirty backwash fluid.

***Note #6**: Following customer P&ID we have not included any manual isolation valves neither for filter housings nor for fuel gas tank (to be checked with customer).*

REFERENCE :
Filter item H46- 081-082-083 P&ID drawings nr. 178 -0041-010 .
Filter item H46- 076-077-078 P&ID drawings nr. 178 -0041-002 .