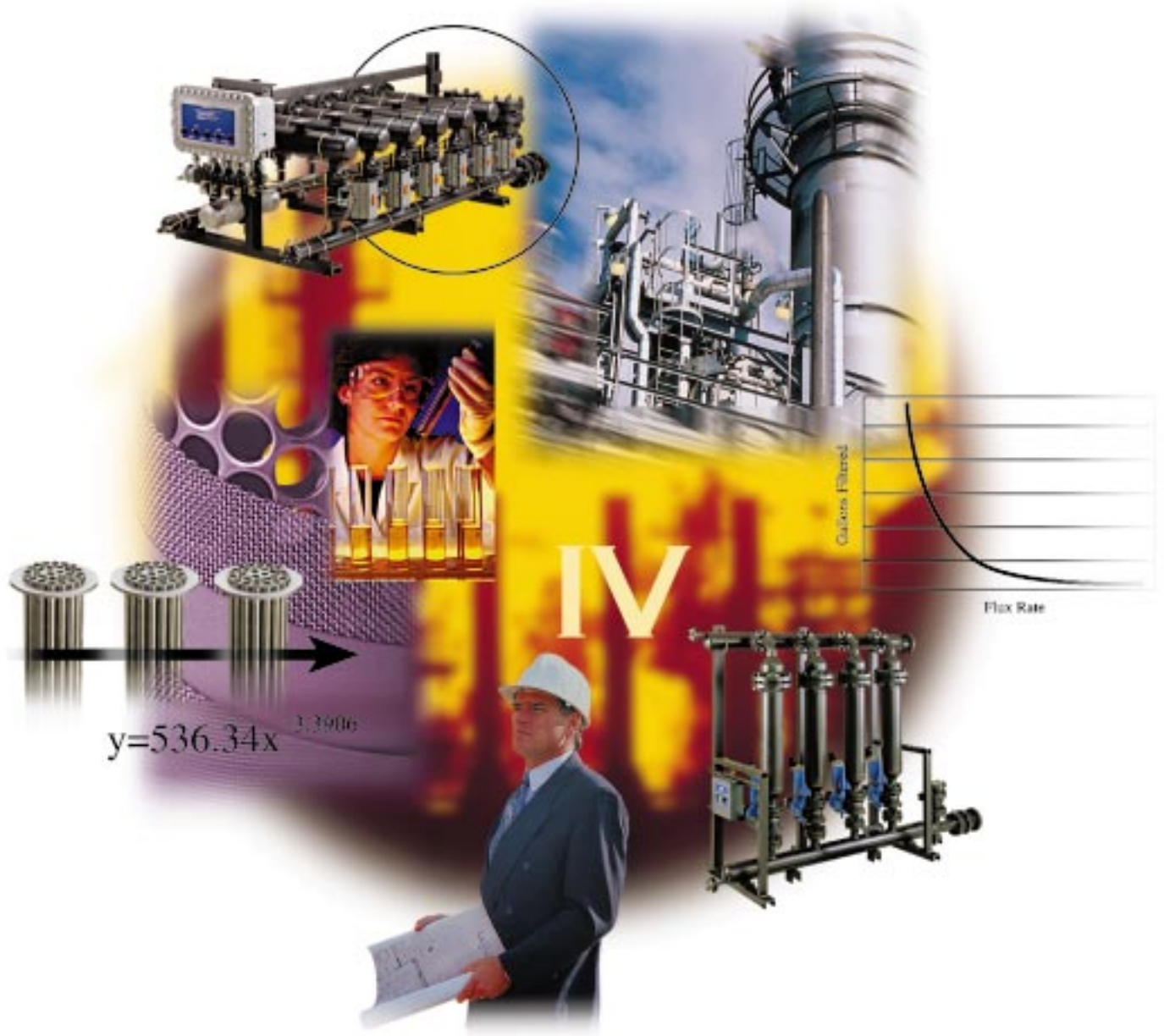
REACTOGARD® IV *Filtration Solutions for Refinery Operations*



A New Standard in Refinery Filtration

The family of REACTOGARD® IV liquid filtration systems, featuring ACCUFLUX™ media, sets a new standard in filtration performance in the protection of fixed bed catalytic reactors and related refinery operations. These automated backwashing systems offer significant advantages in all of the following applications shown below.

REACTOGARD® IV systems are designed to meet the goal of *low flux operation*. This goal is reached with improved media materials and new ACCUFLUX™ element designs that increase filtration area by as much as 300% over previous standards.

In addition, a new multi-bank system and controls approach reduce the number of valves and headers typically by 40% to 60%.

These enhancements deliver the following advantages:

- Highly consistent filtration selectivity.
- Improved filter productivity due to increased run times between filter cleanings and the assurance of more complete media cleaning each cycle.
- Superior mechanical integrity resulting in enhanced serviceability and reduced maintenance.
- Reduced product loss through less frequent backwashing.
- Reduced cost of installed filtration capacity.
- Reduced space requirements.

Vacuum residuum (VRDS)

Atmospheric residuum (ARDS)

Coker Gas Oils (CGO)

Vacuum Gas Oils (VGO)

Diesels

Naphthas

Amines

Vertical Bank

Horizontal Bank

**Patents pending for REACTOGARD® IV Systems and ACCUFLUX™ filter elements*

Low Flux Rates with ACCUFLUX™ Elements:

The Key to More Consisten

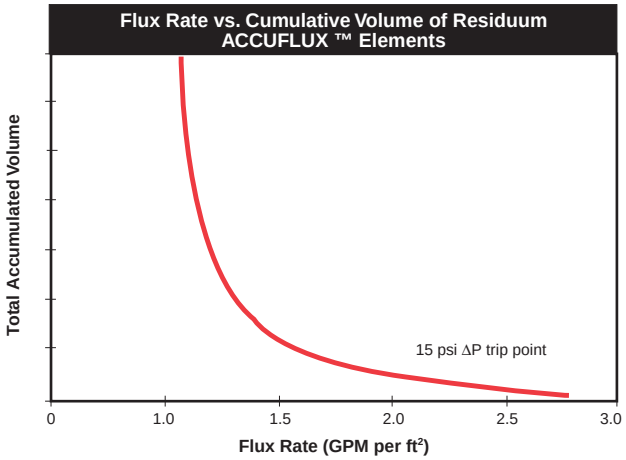
As flux rate (flow through a specific filter area) is lowered, so is the velocity of the liquid and solids going to the filter media. As a result, the solid particles lie on the surface of the media and create a porous particulate cake. A porous cake provides improved efficiencies in particle removal while allowing more liquid to pass, providing higher flow rates for longer periods between filter cleanings.

Lower flux rate makes it easier to clean the filter thorough since particles are not wedged into the media. More thorough cleaning also helps decrease the frequency of backwashings, thereby maximizing overall productivity.

Operating at low flux rate improves filtrate quality since contaminants are less likely to be forced through the medi

It should be noted that all design flux rates are application specific. When filtering heavy feedstocks, flux rates of 1 to gpm/ft² (40 to 80 lpm/m²) are recommended. When filtering lighter hydrocarbons, flux rates are generally higher.

The most efficient way to achieve low flux rate is to increa active filter surface area. This has been achieved with ACCUFLUX™ media elements featuring ultra-high surface area, clustered element designs, and breakthroughs in media materials.



Graph illustrates the effect of lowering flux rate of residuum. The vertical axis is total volume run through the filter until a 15 psid (1.0 kg/cm²) drop initiates a backwash cycle. The horizontal axis is the flux rate (flow per unit area). As the data clearly shows, substantial gains in run time (volume) are achieved by reducing flux rate. In every case, reductions in flux rate result in exponential gains in run time (volume) between backwashings.

Unique element design multiplies surface area

ACCUFLUX™ elements are available in configurations with 8, 19, 28 or 46 individual, replaceable filter tubes offering media area of 6.3 ft² (0.6 m²), 15 ft² (1.4 m²), 22 ft² (2.0 m²), or 36 ft² (3.4 m²). The ACCUFLUX™ 8 and ACCUFLUX™ 28 elements are pictured above. Elements are available in 2–40 micron woven wire and 15–150 micron slotted wedge wire to meet varying particle retention and application requirements.

Woven wire media features more open area, greater flow, enhanced cleanability, and longer life

Woven wire media is used when finer filtration is required or in less rigorous applications. In these cases, ACCUFLUX™ elements with woven wire media represent a major improvement over previously available elements.

First, ACCUFLUX™ woven wire media features greater open area for enhanced forward flow and backwashing characteristics.

Second, the overall design of ACCUFLUX™ woven wire elements promises superior performance. Rather than a five-to-seven layer structure, ACCUFLUX™ elements have a single woven wire filtration layer that is supported by an underlay and overlay of open stainless steel mesh. Structural integrity is provided by a perforated stainless steel inner support tube with approximately 50% open area. The filter media is efficient at removing contaminants in the 2 micron to 40 micron range and are ΔP-rated to 100 psid (7.0 kg/cm^2).

The ACCUFLUX™ mesh structure makes higher flow rates possible and provides superior cleanability since particles do not become locked into, and between, multiple layers. Longer life is assured since these elements provide a higher structural rating than multi-layered designs.

Wedge wire media features 33% greater open area

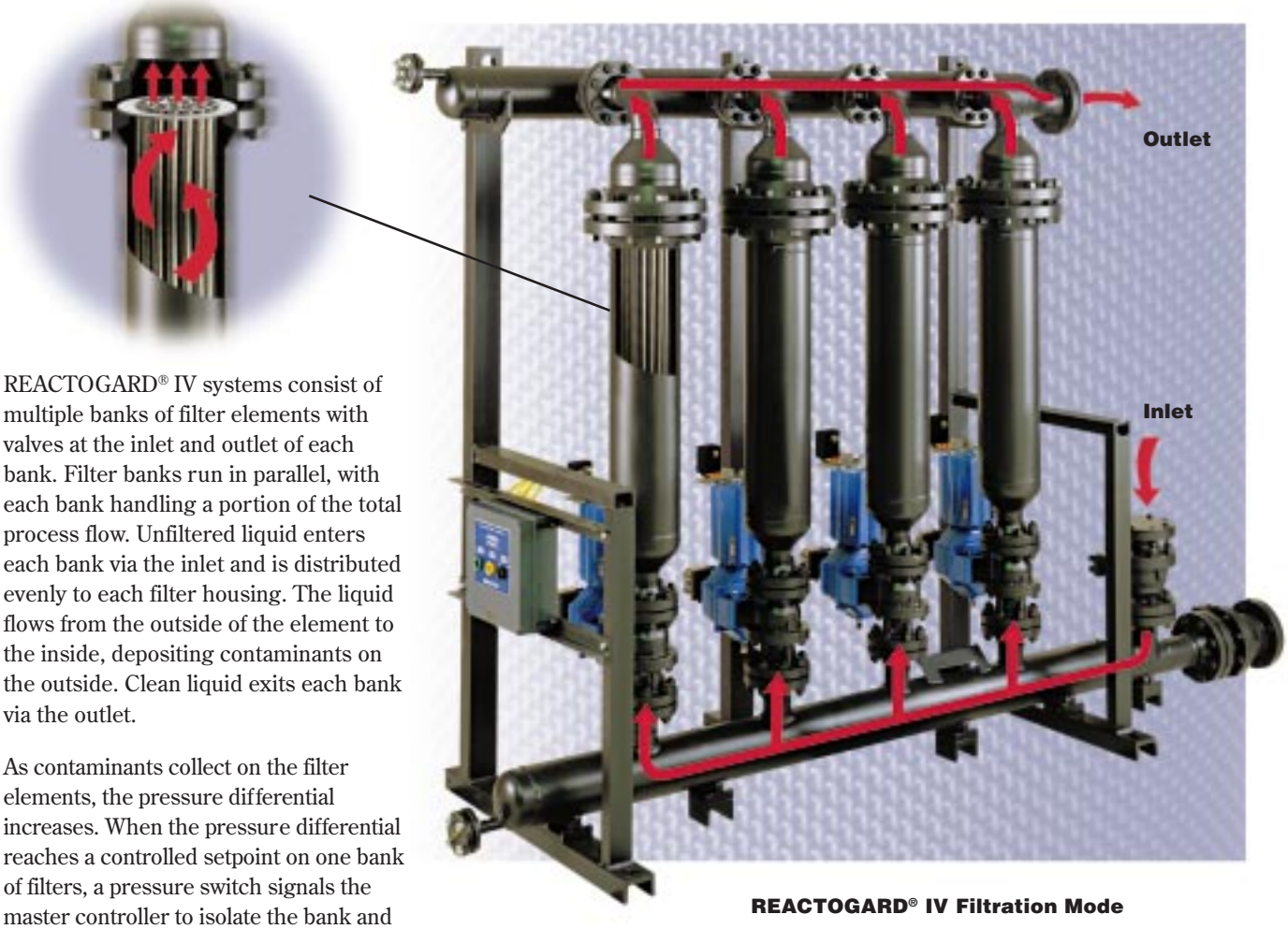
Wedge wire media is highly durable and the superior choice for filtering heavy, corrosive feedstocks with high dirt loads. They are much easier to clean thoroughly, thereby maintaining high filtration flow rates. ACCUFLUX™ wedge wire elements are constructed with 0.02 inch (0.5 mm) width wedge wire and offer 33% more open area than the previous industry standard. These elements have a nominal rating of 23 micron that effectively remove the particles that plug fixed catalyst beds in hydroprocessing reactors. However, slot width of 15–150 microns is available for specific applications.

In summary, ACCUFLUX™ elements and media provide superior durability, cleanability, filtration performance, and operational flexibility.

Wedge wire media approved and applied for vacuum resid service.

Simplicity of System Design:

The Key to Low Installed Cost and Reduced Maintenance



REACTOGARD® IV Filtration Mode

REACTOGARD® IV systems consist of multiple banks of filter elements with valves at the inlet and outlet of each bank. Filter banks run in parallel, with each bank handling a portion of the total process flow. Unfiltered liquid enters each bank via the inlet and is distributed evenly to each filter housing. The liquid flows from the outside of the element to the inside, depositing contaminants on the outside. Clean liquid exits each bank via the outlet.

As contaminants collect on the filter elements, the pressure differential increases. When the pressure differential reaches a controlled setpoint on one bank of filters, a pressure switch signals the master controller to isolate the bank and begin the backwash cycle. Systems are backwashed using filtered liquid or by introducing a separate backwash liquid.

When cleaning is required, the system operates without interruption. A single filter bank that requires cleaning is momentarily isolated from the feed flow and purged as the application requires. Then, each filter element on that bank is cleaned sequentially. This method assures that the total backwash energy is directed to individual elements, thereby providing more thorough cleaning. Complete element regeneration is the key to longer runs between cleaning cycles and greater productivity.

Cleaning cycle times of less than one minute per bank assure high productivity is maintained.

This system design reduces the number of valves and headers typically by 40% to 60% compared to earlier refinery filters, dramatically reducing installation costs and maintenance requirements. Other system features include:

- Flanged valves (vs. socket welded valves) in standard ANSI dimensions, simplify serviceability and replacement.
- Hardened alloy valve seats offer 4–5 times the life of carbon graphite.
- Filter banks can be configured vertically or horizontally to provide installation flexibility, save space, and improve serviceability.
- Actuators are located on valves so there are no mechanical linkages to maintain or adjustments to make.
- All components are flanged for enhanced serviceability.
- Systems are easily forward purge adaptable when handling high sulphur feeds.
- Programmable Logic Control (PLC) with electronic interface to control rooms provides control flexibility and reliability.
- Simpler, less costly installation requirements.

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