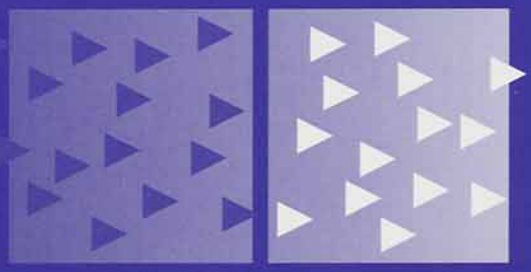


EATON

Application Brief on Amine Filtration

Minimizing the Hazards

and Costs Associated

with Filtration of

Gas-Treating Amines

Solving Amine Filtration Problems Without Creating New Ones

Unless solids such as pipe scale, rust, iron sulfide and down-hole sand are removed from amines, they'll foul flash drums, heat exchangers, strippers, reboilers and carbon bed filters. They'll also remove natural protective films from internal piping surfaces, contributing to accelerated pipe erosion.

While refiners have sometimes used filters with disposable media such as cartridges or throwaway bags to remove these solids, many are now switching to cleanable-media filters such as Ronningen-Petter Clean-In-Place Filters.

That's because Clean-In-Place Filters effectively remove solids from amines to protect downstream equipment. But unlike disposable filters, they minimize hazards and costs associated with amine filtration.

The rest of this application brief reviews the problems involved with using disposable filters for amines, and explains specifically how Clean-In-Place Filters overcome them.

The problems with disposable media

Media disposal poses a big and growing problem

Today, it costs far more to dispose of amine-saturated cartridges than it does to buy the cartridges. For example, if you have a medium-size 66-cartridge system and change out cartridges daily, you could spend almost $100,000 a year on disposal costs alone—*for that filter alone*. See Table 1.

Then, because you're dealing with cartridges soaked with amine, they must be disposed of in accordance with regulations governing either hazardous material (if disposed of on-site) or hazardous waste (if shipped off-site). So add to your disposal costs the cost and bother of record keeping.

Exposure poses hazards

With their load of H_2S, amines are extremely offensive and hazardous. Thus, each time you open a filter, you expose workers to a potentially hazardous situation. With disposable-media filters, this is unavoidable because every media changeout requires opening the filter. What's more, filtration of amines often requires frequent changeouts due to the amount of solids loading.

With disposable media, continual media purchase costs and labor for changeouts add up

With disposable media, you're constantly replacing dirty media with new media. Even for a 66-cartridge system which needs changing daily, that can add up to almost $70,000 a year, as shown in Table 2.

What's more, changing out cartridges is a slow, time-consuming process. First, an operator must either stop the system, bypass the filter or reroute the process flow to another filter. Then, for a typical system, he must physically remove the filter lid, compression seals, cartridges, seal plates and more cartridges—then reassemble everything.

Clean-In-Place Filter Systems dramatically reduce disposal costs and concerns, eliminate hazards

Unlike disposable-media filters, Ronningen-Petter Filters have cleanable media, so they can be used over and over. In fact, some of these media are so tough, they may never need replacing.

So there are no new media to buy, and nothing to landfill or incinerate. You only have a very small waste stream to contend with.

How small is small?

The waste stream produced by a Clean-In-Place Filter can be as low as 0.069% of a unit's total output.

For example, take a four-tube Clean-In-Place Filter handling 150 GPM. On this filter, each tube requires 12.5 gallons of cleaning liquid, usually water, or 50 gallons for all four tubes per cleaning cycle. Assuming cleaning is needed

Table 1 — Annual Cartridge-Disposal Costs

Number of Cartridges in Filter	Cartridge Changeout Frequency in Days		
	1	4	7
36	$52,500	$13,125	$7,500
66	$96,250	$24,062	$13,750
88	$128,333	$32,083	$18,333
120	$175,000	$43,750	$25,000

This chart shows how much you can spend getting rid of amine-saturated cartridges based on changeout frequency. For example, you can spend nearly $100,000 annually changing out a 66-cartridge system daily. This assumes 10" cartridges are used and that a carefully filled 55-gallon drum can hold 180 of them. Disposal costs are assumed to be $750 per barrel (U.S. dollars), and calculations are based on 350 operating days per year.

Table 2 — Annual Cartridge-Purchase Costs

Number of Cartridges in Filter	Cartridge Changeout Frequency in Days		
	1	4	7
36	$38,800	$9,450	$5,400
66	$69,300	$17,325	$9,900
88	$92,400	$23,100	$13,200
120	$126,000	$31,500	$18,000

This chart reviews how much you can spend on new cartridges based on the frequency of changeouts. For example, it shows you'll spend almost $70,000 annually by changing out one 66-cartridge filter on a daily basis. Costs are assumed to be only $3 (U.S. dollars) apiece — which is very conservative — for simple, string-wound cartridges, and calculations are based on 350 operating days per year.

every four hours (which is typical), the filter would use a total of 300 gallons of cleaning liquid a day. To put this in perspective, a typical flow through this filter is 432,000 gallons per day. This means the total cleaning liquid is only 0.069% of the unit's total output per day.

Harmless waste stream can be sent to waste treatment plant

Before the tubes on a Clean-In-Place Filter are cleaned, usually with water, nitrogen automatically purges the amine liquid from the tubes and into an amine recycle header. This prevents any amine from contaminating the waste stream. As a result, the waste stream is composed only of water and dirt particles—which can be handled easily and inexpensively by a waste treatment plant.

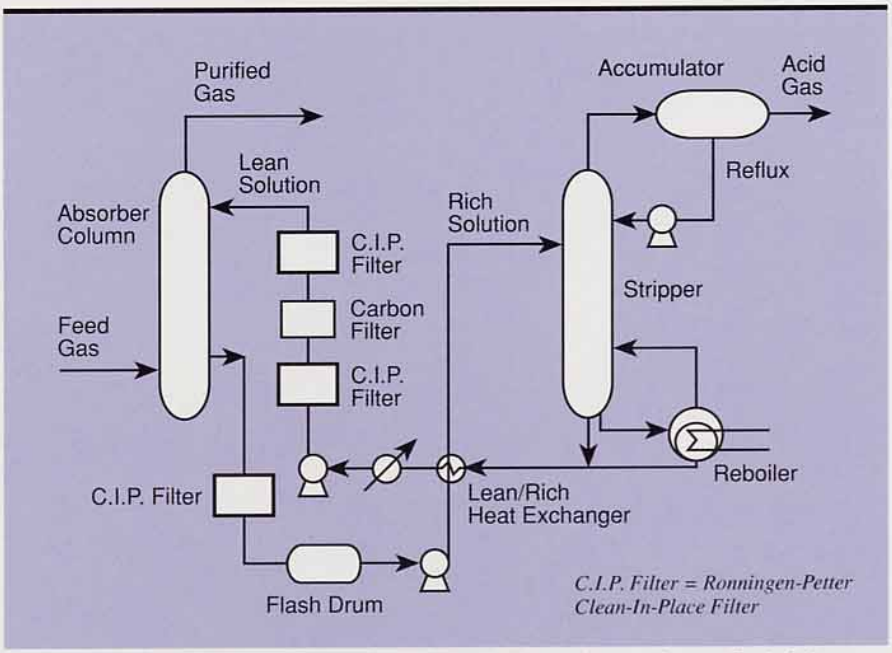
Because the media is cleaned in place, labor costs and exposure hazards are virtually eliminated

Valving the tubes in parallel to common headers on Clean-In-Place Filters is what allows the filters to be cleaned in place.

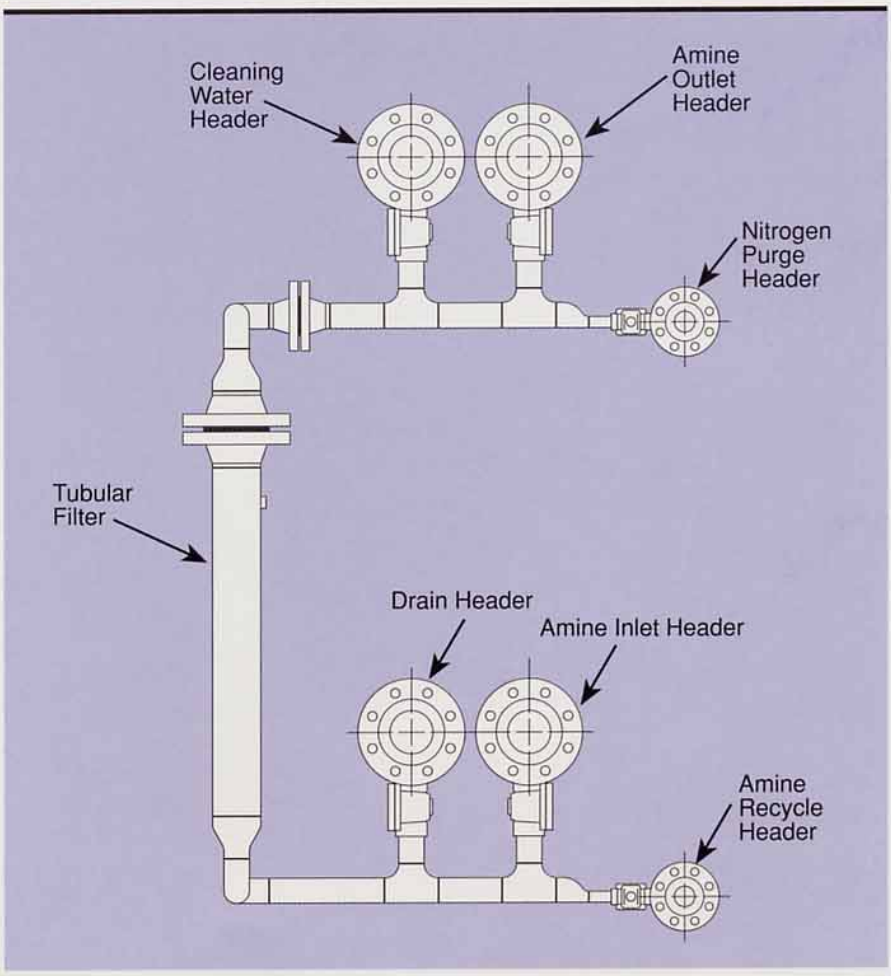
"Cleaned-in-place" means water is momentarily reversed through the tubes to clean the media, then travels into a drain header. You don't bypass the filter or re-route the process flow. What's more, the entire system is automated so the filter cleans itself.

Because cleaning takes place in a closed system, there's no risk of exposure to operators. And because tubes are cleaned in pairs while the others remain onstream, you get continuous flow to your process.

Clean-In-Place Filters can consist of as many tubes as necessary to handle any flow rate.

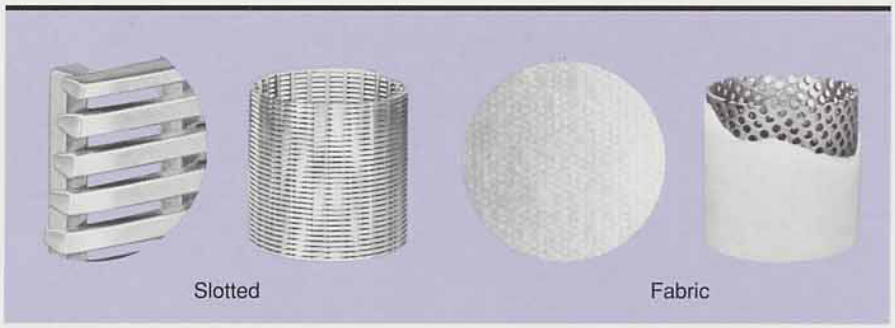


Schematic above shows where Ronningen-Petter Clean-In-Place Filters work most effectively in refineries. Note that C.I.P. Filters are used before and after the carbon filter. Reason: The filter before the carbon filter removes solids that could plug the carbon unit prematurely and reduce its efficiency. The filter after the carbon filter removes migrating carbon carryover that could plug beds in the absorber column.



Using nitrogen to purge liquid amines from tubes before cleaning prevents waste stream contamination.

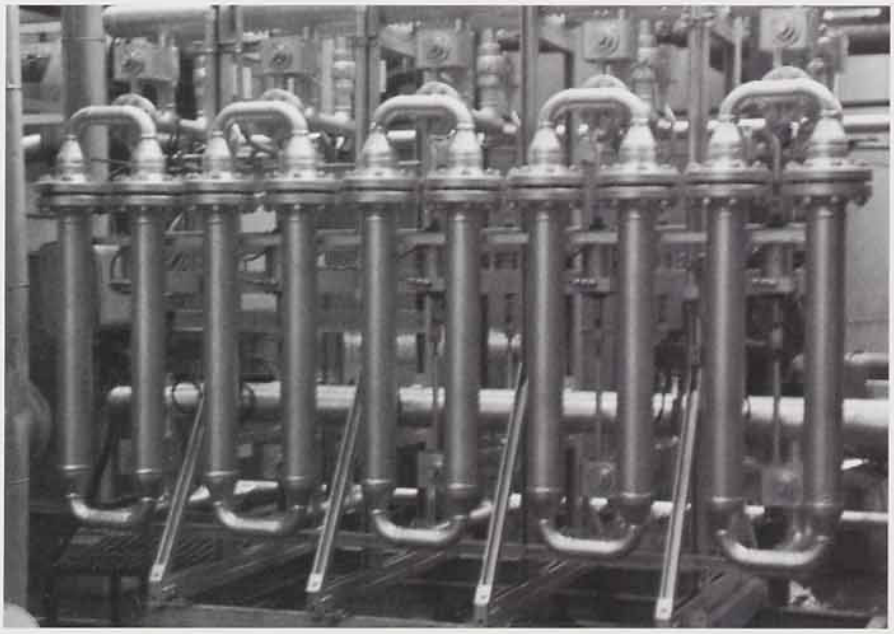
Wide Range of Filter Media for Amine Systems



Two cleanable media types are available—slotted stainless steel and various woven fabrics—in filtration levels from 10 mesh to 1 micron. Amine sweetening units generally require media with retentions of 10 to 25 micron. For the elevated temperatures and pressures experienced in these systems, 10 to 25 micron slotted 316L stainless steel screens are usually recommended.

Call or write for more information

With our extensive filtration experience in hydrocarbon applications worldwide, Ronningen-Petter is uniquely qualified to help you assess the benefits of a Clean-In-Place Filter System for your gas sweetening application.



In operation since early 1992, this Ronningen-Petter flanged filter is equipped with 25-micron slotted elements and is successfully removing particles from amine. Operating conditions: temperature, 202°F (94°C); flow rate, 330 GPM (75 m³/h); pressure, 247 PSI (17 bar).

EATON

QUALITY SYSTEM ISO 9001 • CERT. NO. 30002 •

9151 Shaver Road
Portage, Michigan, USA, 49024
Email: info@eaton.com
Toll Free: 1-800-656-3344
(269) 323-1313