

Coalescer Filter and Media Supplier Program

Detailed forecasting of markets, prospects and projects around the world to remove liquid droplets from oil and gas and to remove mercury from gas.



Mcilvaine Company
Northfield, IL

Deliverables - Components

The service covers markets and technology for liquid/gas and liquid/liquid coalescing filters and filter media. Vane, mesh pad, fiber bed/candle, electrostatic and cartridge coalescer filter types are included for both stationary and mobile applications. It also covers ionic liquid impregnated pellets and carbon adsorbers for mercury removal.

Initial Deliverables

- Electronic report with analysis and forecasts
- Networking Directory of OEMS, suppliers, purchasers
- Market shares of suppliers

Continuing Updates

- Continuing updates of online forecasts, competitor profiles, regulatory developments
- Periodic web meetings to discuss updates and changes
- Periodic excel files with revised forecasts
- Continually updated directory of OEM suppliers, filter competitors, media and component suppliers

Deliverables - Content

Content Description	Initial	Ongoing
Revenue forecasts by unit and \$	Forecasts with online access and excel file	Continuous updates and quarterly excel file
OEM supplier analysis	Top OEMS with profiles and estimated purchases	Continued expansion of analysis
Price analysis by filter and media type	Extensive	Expanded
Technology evaluation and trends	Extensive	Expanded
Regulatory developments	Major regulations analyzed	Updates and changes
Descriptions of filters and media	Difference between types in terms of design and performance	Expanded
Networking Directory of suppliers and OEM customers	World wide coverage of the OEM filter purchasers as well as the components suppliers	Continually expanded
Web based market discussions	Custom discussion	Periodic multi-client

Deliverables - Segmentation

- Liquid/Gas coalescing filters by type and efficiency
- Liquid/Liquid coalescing filters by type and efficiency
- Filter media description
- Mercury removal absorbents and vessels
- Potential for removing mercury in dehydration sieves
- Market revenue by geographic and industry segmentation
- Industry and mobile applications
- OEM supplier data

Forecast - Segmentation

Geographic

- World is segmented into 80 countries and regions so that there is a meaningful market in each segment
- Grouped displays are then shown for sub regions, regions, continents and total world

Coalescer type

- Liquid/Gas
- Liquid/Liquid

- 80 countries, two coalescer types, multiple applications, filter and media types, multi-year year forecast
= multiple forecasts
- Forecasts which can be updated quarterly
 - excel spreadsheets and online interactive searches
 - using the format in the Mcilvaine automotive catalyst market forecasts (shown in following slides)

Applications

- Oil & gas, chemicals, fuels, food & beverage, power, mobile (on and off road), marine, aviation

Geographic Segmentation - Example

Select continent of Asia, then East Asia. There are separate displays for many countries but the small countries are grouped into Other East Asia.

East Asia

- Australia
- China
- Hong Kong
- Indonesia
- Japan
- Malaysia
- New Zealand
- Philippines
- Singapore
- South Korea
- Taiwan
- Thailand
- Vietnam
- Other East Asia

Other East Asia

- American Samoa
- Brunei
- Cambodia
- Cook Islands
- East Timor
- Fiji
- French Polynesia
- Guam
- Kiribati
- Laos
- Macau
- Marshall Islands
- Micronesia
- Mongolia
- Nauru
- New Caledonia
- Niue
- North Korea
- North Mariana Islands
- Palau
- Papua New Guinea
- Samoa
- Solomon Islands
- St. Helena
- Tokelau
- Tonga
- Tuvalu
- Vanuatu
- Wallis & Futuna

Liquid/Liquid Coalescer Cartridge Markets

\$ millions - Oil and Gas Industry

COUNTRY	2014	2015	2016	2017	2018	2019
United States						
Canada						
Mexico						
Argentina						
Brazil						
Chile						
Colombia	5.94	6.28	6.65	7.02	7.43	7.91
Ecuador	3.79	3.98	4.20	4.42	4.68	4.94
Guatemala	0.00	0.00	0.00	0.00	0.00	0.00
Peru	0.78	0.82	0.89	0.97	1.04	1.11
Venezuela						19.02

Market Shares for Liquid/Liquid Coalescers

Company	L/L Cartridge Revenue (\$million)
Pall	
PECOFacet	
ParkerVelcon	
Pentair	
Jonell	
Faudi Aviation	
Kaydon	
Sulzer Chemtech	
Others	
Total	

Liquid - Liquid Contaminants Removed

Oil & Gas

- water removal
 - equipment protection; meet specifications of process chemicals and final product
- hydrocarbon removal
 - from amine sorbent for regenerator protection
 - from wastewater and produced water streams
- carryover caustic removal, recovery during treatment processes

Fuels

- haze removal
- sodium removal
- supply chain contaminant removal (dust, pipe scale, algae, water) at distribution/transport/dispense points

Chemicals/ Pharmaceuticals

- hydrocarbon removal from ethylene quench water (a building block chemical)
- water removal from aromatics and other
- oil separation from ammonia, urea, acid, caustic streams and other
- organics separation from acid/caustic pharmaceutical extractants

Liquid - Liquid Media Suppliers

- Lydall Filtration/Separation, Inc. offers their LyPore® Unity™ liquid/liquid and liquid/gas coalescing media grades for efficient separation of both water from other liquids and oil and water from air streams. All grades are constructed with borosilicate microfiberglass that offers the highest level of coalescence at the lowest pressure drop. Lydall's fluoropolymer oil and water repellency treatment processes ensure exacting separation of target compounds and long element life. LyPore® Unity™ grades can be pleated or wrapped and are available in a wide range of efficiencies, repellency levels, and binders.
- Hollingsworth & Vose (H&V) manufactures a comprehensive line of coalescer media solutions for applications that require gas-liquid and liquid-liquid separation. H&V offers a choice of fiberglass, cellulose, and synthetic media combined with specialized organic binders. H&V microfiberglass media fibers are naturally oleophobic, so oil droplets adhere but do not swell them. The cellulose coalescer media is an economical alternative to glass. For applications requiring additional structural integrity, these media are also available with lamination.

Liquid – Gas Contents

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Liquid – Gas Scope

Scope

The market for gas cartridge coalescers for the natural gas industry is examined in this report. Liquid from gas (L/G) cartridge coalescers are high efficiency filters used to remove aerosols from natural gas streams to ensure pipeline quality gas, protect downstream equipment and product recovery.

The scope of this project covers L/G coalescer applications in the following areas:

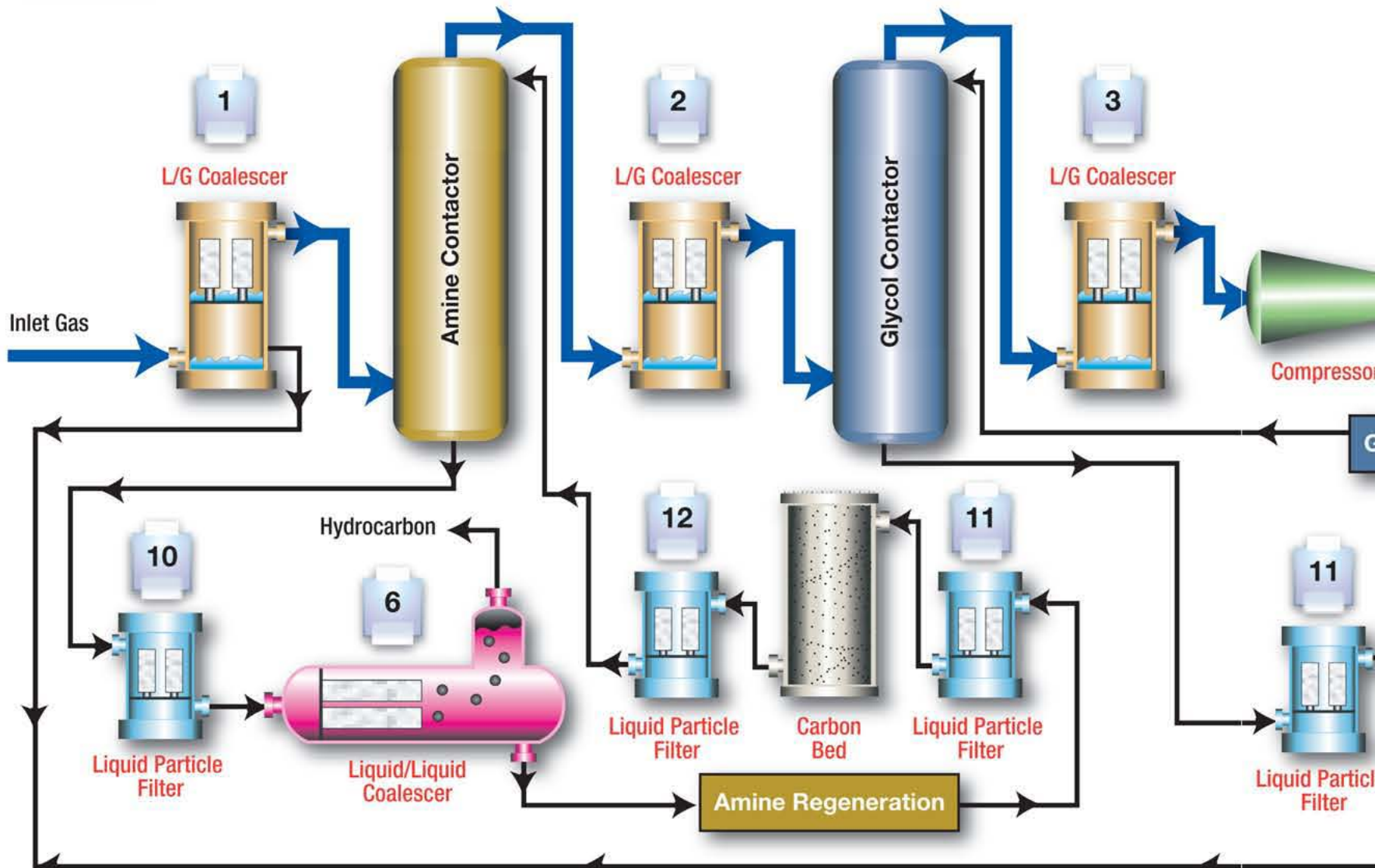
- Gas processing plants
- Pipeline compressor stations
- Storage
- LNG liquefaction / Regas plants

The principles of separation and coalescing, types of equipment used, and applications in the natural gas processing industry are discussed. Revenue forecasts for each country, sub-region, and continent are provided. Competitor revenues and market shares for L/G coalescers, market drivers, and industry regulations are included.

Excluded from scope but also important widespread markets for L/G coalescers are industrial processing applications such as oil mist lubrication and air compression.

Liquid/Gas Coalescer Market

- Natural gas processing consists of separating hydrocarbons and fluids from the pure natural gas to produce 'pipeline quality' dry natural gas to be fed to gas transportation systems. High efficiency cartridge L/G coalescers are used for vapor removal from the gas stream during processing and transportation. Typically they are used downstream from other separation equipment such as mist eliminators (vane, mesh pads) that remove larger droplets.
- **Revenue**
- The worldwide revenue for liquid/gas high efficiency coalescer cartridge filters is \$2xx million and projected to grow over the next 5 years to \$2xx million. The United States has a 30 percent share of revenue at \$ xx million based on capacity reports. Russia is the second leading gas producer, with an estimated \$ xx million in revenue for this market.
- Demand for natural gas is projected to increase, and thus will continue revenue growth as new facilities and pipeline projects are built. In the U.S. the continued development of shale gas will meet demand worldwide.
- The replacement market is strong, with filters on a 12-18 month replacement schedule.



All suppliers and customers are identified with a corporate number- this is very important for Chinese suppliers and customers where translations of names are confusing and often at variance

Company English Name	Corporate #	Chinese name
Zhejiang Tiandi Environmental Protection Engineering	1291	浙江天地环保工程有限公司
Zhejiang Tianlun Environmental Protection Equipment Co.	23239	
Zhejiang Tiantai Industrial Cloth Factory	701	浙江天台县工业用布厂
Zhejiang Tiantai Nonwoven	24342	
Zhejiang Tiantai Wenxing Non-woven Cloth Industry	680	浙江天台文星无纺布业有限公司
Zhejiang Tri-Star Special Textile	778	浙江三星特种纺织品有限公司
Zhengjiang Fei Li Da Polymerie Materials Co.	24568	
Zhengte Valve	1453	温州正特阀门有限公
Zhengzhou Xinli Power Co.	23749	

Networking Directory

All subsidiaries are displayed under corporate # and then contacts at each.

Example: Ahlstrom Finland

There are listings for both suppliers and OEM customers.

Ahlstrom - KY, USA, 1
Ahlstrom Air Media - OH, USA, 1
• Ahlstrom Aquaflow - NY, USA, 1
• Ahlstrom Barcelona, S.A. - SPAIN, 1
Ahlstrom Corporation - FINLAND, 11
Ahlstrom Engine Filtration LLC - SC, USA, 3
• Ahlstrom Engine Filtration LLC/Fiber Composites Dv. - IL, USA, 1
• Ahlstrom Filtration - TN, USA, 8
Ahlstrom Filtration LLC - CA, USA, 2
Ahlstrom Filtration LLC - OH, USA, 1
• Ahlstrom Filtration LLC - PA, USA, 10

Name (Link to Interest Areas)	Title	Email	Telephone	Source
Jan Kaukopaasi		jan.kaukopaasi@ahlstrom.com		General Interest from 5/2014 to 11/2014
Jan Laeng	President & CEO	jan.laeng@ahlstrom.com		General Interest 5/2013 to 11/2013
Jukka Tuominen	Manager/Products HRSG	jukka.tuominen@ahlstrom.com		General Interest 5/05 to 11/05
Laura Raitio	Sr. V-P/Glass& Ind'l.Nonwovens	laura.raitio@ahlstrom.com	358-10-888-4766	General Entry from 5/09 to 11/09
Liisa Nyyssoenen	Vice-Pres./Communications		358-10-888-4757	General Interest 5/2013 to 11/2013
Paul H. Stenson	Exec. V-Pres./Prod.&Tech. Dev	paul.stenson@ahlstrom.com		General Interest 5/3/2011 to 11/2011

Mercury Removal from Natural Gas



Ionic Liquids for Mercury Removal

A new process...

A novel ionic liquid-based technology for mercury removal from natural gas feeds

Two key aspects

- Custom design of ionic liquids that can both oxidise and capture mercury
- Impregnation onto solid supports

Result

- High performance scrubber for mercury capture (all forms) that can be used directly in existing MRUs with no changes to process operation



Metal Based Sorbents have Advantages for Wet Gas

- The mercury removal capacity of sulfur impregnated activated carbon adsorbents is reduced by the presence of liquid hydrocarbons and moisture. But, as MRUs move to the front of the gas plant, liquid hydrocarbons and moisture are more likely to be present. Sulfur is highly soluble in liquid hydrocarbons and will be “washed away.” Moisture can be co-adsorbed into the micro-porous substrate, leading to a decline in mercury removal performance. The mercury removal capacity of metal-based sorbents, on the other hand, is not compromised by the presence of liquid hydrocarbons or moisture.
- As an example, a gas plant commissioned in Thailand in 2004 had the MRU located upstream of the acid gas removal unit and the dehydrator. The MRU was initially charged with sulfur impregnated activated carbon designed for a ten-year life, but experienced premature mercury breakthrough after just two years. The MRU was refilled with a copper sulfide sorbent and has operated continuously since that time without breakthrough.
- Metal-based sorbents have also been shown to be more effective in removing higher concentrations of mercury and are particularly suitable for fields where mercury concentrations vary significantly from day to day or even hour to hour. For example, mercury concentrations at the inlet to the Berri gas plant in Saudi Arabia averaged 30-40 $\mu\text{g}/\text{Nm}^3$, but experienced spikes of over 100 $\mu\text{g}/\text{Nm}^3$. Activated carbon sorbents were unable to consistently achieve the target outlet concentration of .01 $\mu\text{g}/\text{Nm}^3$. A change out to copper sulfides successfully reached the outlet target on a consistent basis.

Cost is Less Than Packed Columns



Evaluation



Gas-liquid contactor --- Data by PoroGen	Specific surface area (cm ² /cm ³)	Volumetric mass transfer coefficient, (sec) ⁻¹
Packed column (Countercurrent)	0.1 –3.5	0.0004 –0.07
Bubble column (Agitated)	1 –20	0.003 –0.04
Spray column	0.1 –4	0.0007 –0.075
Membrane contactor (PEEK)	1 –70	>0.1

Reduction & Savings --- Data by Aker Process System

- Capital cost by 35 -40%;
- Operating costs of 38% -42%;
- Dry equipment weight of 32% -37%;
- Operating equipment weight of 34% -40%;
- Total operating weight of 44% -50%;
- Footprint requirement of 40%.

Reduction & Savings --- Data by WP

- Capex reduction of 35-40% due to smaller equipment, Smaller footprint (floating LNG is possible)
- Opex savings between 30-40% due to Lower energy requirement for regeneration, higher pressure operation (less compression required), Minimal hydrocarbon losses, Reduced foaming

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