Coalescer Filter Market in the Oil & Gas Industry

Including an analysis of oil price fluctuations

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Filtration for oil and gas is a $3 billion industry. A number of different types of filters are used in the industry, from macro to micro filtration. This report focuses on one essential segment, separating small droplets from natural gas streams using high efficiency cartridge filter coalescers.

The revenue for liquid from gas high efficiency coalescer cartridge filters is over $200 million per year and projected to grow over the next 5 years to almost $220 million. The table below illustrates the regional breakdown for 2015.

<table>
<thead>
<tr>
<th>Region</th>
<th>Revenue by Region ($million)</th>
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<tbody>
<tr>
<td>NAFTA</td>
<td>71.62</td>
</tr>
<tr>
<td>South &amp; Central America</td>
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<tr>
<td>Western Europe</td>
<td>12.87</td>
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<tr>
<td>Eastern Europe</td>
<td>0.97</td>
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<td>CIS</td>
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<td>Africa</td>
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<td>Middle East</td>
<td>28.99</td>
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<td>East Asia</td>
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<td>West Asia</td>
<td>5.22</td>
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<td>WORLD</td>
<td>201.00</td>
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</table>

NAFTA accounts for over 35% of the revenue, with the United States posting the largest revenue at over $60 million. The CIS region, including Russia, has over 18% of world revenue. Here is a breakout of regions by percentage of total world revenue.
Overview

Natural gas processing consists of separating hydrocarbons and fluids from the pure natural gas to produce ‘pipeline quality’ dry natural gas to meet specific quality measures.

Liquid aerosols are formed by condensation, atomization, and re-entrainment from upstream separation equipment. Condensation and atomization usually form fine aerosols smaller than one micron in diameter. High efficiency cartridge liquid/gas coalescers are used for vapor removal from the gas stream during processing and transportation, often used downstream from other separation equipment such as mist eliminators (vane, mesh pads) that remove larger droplets.

Technology

Coalescers, typically manufactured as either pads or cartridge filters, are designed to take small droplets in a gas stream and grow them into large drops to allow separation by gravity. This is accomplished with pore gradient of medium, with inlet of fine pore sizes that increase in size with flow direction.

More than one stage of separation is required. Several technologies are available to remove liquids and solids from gases: gravity separators, centrifugal separators, mist eliminators and liquid/gas cartridge coalescers. A mechanical separator uses a series of filters or dividers to induce water molecules to move from a mixture to collect together. Electrostatic coalescers use a weak electric charge to increase the droplet size for removal, and are usually seen in liquid/liquid coalescers.

Different technologies are used for different droplet size removal, from sprays greater than 10 microns to mists less than 10 microns to aerosols 1 micron or less.
Gravity separators – also known as knock out drums, are used for bulk separation or a first stage scrubber. Knock out drums will remove larger droplets (>300 µm), followed downstream by a mist eliminator and/or a high efficiency cartridge coalescer. The different stages can be in separate vessels or in one vessel. The force used to separate solids and liquids from gas is gravity.

Centrifugal Separator— also known as a cyclone separator, can remove droplets down to 8-10µm.

Mist Eliminators – Mist eliminators have lower efficiency at the submicron size, thus allowing some vapor droplets to escape. There are three types of mist eliminators:

- Vane, also known as baffle, chevron or plate type, are closely spaced blades arranged to provide zig-zag gas flow paths, using inertial impaction for droplet removal >10µm. Vane mist eliminators are sturdier than mesh pads and impose less pressure drop, and are also sometimes used in combination with mesh pads.
- Mesh pads, with the most typical structure being a knitted pad in tightly packed layers, use media composites of plastics or glass that coalesce droplets > 1.0 µm. Media of metal or plastic wire are used for droplets > 5.0 µm. A large vessel is required and is operated at low velocity.
- Fiber bed/ candle types use fine fibers (cellulose, glass, or plastic) packed into a mat with thickness of a few inches. These fiber mist eliminators are in cylindrical form (candles) or flat panels and offer > 0.5 µm removal. These mist eliminators remove sub-micron liquid aerosols from gas streams, but have higher pressure drops than cartridges. Fiber bed filters have a large contacting surface and are used in applications including acid mist removal and oil mists created in various processes.

Coalescer cartridges offer high removal efficiencies down to > 0.1 µm. Usual configuration is vertical, where gas travels upward and flows from inside to outside of cartridge, where submicron droplets coalesce into larger droplets, then drain down. Liquid from gas cartridge coalescers can operate at peak performance at reduced flow rates (i.e., during partial shutdowns).

A high-efficiency vertical liquid/gas coalescer can be designed for inlet gas with liquid aerosol contamination that enters at the bottom of the housing into a first-stage knockout section. Here any slugs or large droplets are removed by gravitational settling. The gas then travels upward through a tube sheet and flows radially from the inside of the cartridges through the coalescer medium to the annulus. The inlet aerosol distribution ranges from 0.1 to 300 μm, and after passing through the coalescer medium, is transformed into enlarged coalesced droplets ranging from 0.5 to 2.2 mm.

Media

Media for high efficiency cartridge coalescers is typically glass fibers for higher efficiency, treated with oleophobic/ hydrophobic finish. Two of the largest media companies are Lydall and Hollingsworth and Vose.

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. For applications requiring additional structural integrity, these media are also available with lamination. Microfiberglass provides superior coalescence of the smallest contamination droplets. Cellulose media are rugged and economical. Carded nonwovens are suitable as coarse layers and protective wraps.

Applications

Liquid from gas coalescers can be used upstream for equipment protection or downstream for product recovery. Specific applications in the gas processing industry include:

Well Head Hydrate Inhibition: Removing aerosols directly at the wellhead is an effective way to prevent issues downstream and reduce chemical injection (i.e., glycol) costs.

Amine contactor protection / carryover recovery: Amines absorb sulfur compounds from natural gas to produce what is known as sweet gas. The solution can be reused repeatedly. Contaminants can cause foaming, corrosion and plugging of equipment. Also, amine carried over into the sweet gas can result in fouling of downstream equipment including compressors and burners, and product loss. Before entering the absorber, the gas is passed through a system of separators, mist eliminator pads, and if aerosols are determined to be present, high efficiency coalescing filters are used. L/G coalescers can also be installed downstream for product recovery.

Glycol contactor protection/ carryover recovery: Glycol injection systems remove water and other solids from the gas stream. Excessive amounts of liquid and solid contaminants present in the process stream can cause fouling and foaming problems. Coalescers installed upstream will protect contactors, installed downstream of the glycol dehydration system will protect the molecular sieve bed from glycol carryover.

Molecular sieve protection: Molecular sieves are used to dehydrate gas. When water, hydrocarbon and solid aerosols are present, the molecular sieves can reach maximum capacity and lead to frequent regeneration.

Compressor protection / lube oil recovery: Compressors at gas and LNG processing facilities require contaminant free gas to avoid failure and frequent costly maintenance. Also, pipeline compressor stations need filtered gas - even though it left the gas plant “clean and dry” it can pick up particulates and liquids along the way. Recovery of lube oil downstream of a compressor is the primary reason for installing a coalescer on the outlet of a compressor.

Low and ultralow NOx burner protection: Burners at refineries are used for furnaces, cracking, gas turbines, etc. The advanced low and ultra low NOx burners to meet environmental regulations in the United States have finer orifices and are more prone to fouling than the older designs, which can cause unacceptable increases in NOx emissions and maintenance costs. High efficiency coalescers can be installed directly upstream.
Natural Gas Processing Outlook

Global gas demand is projected to grow 2% on average between 2014 and 2020, according to the International Energy Association’s Medium-Term Gas Market Report, 2015. Lower prices will feed a pick-up in global natural gas demand over the next five years following a marked slowdown in 2013 and 2014. The following table from the EIA Annual Energy Outlook 2013 shows U.S. natural gas production steadily increasing through 2020.

![U.S. Natural Gas Production Forecast](image)

The U.S. gas production will continue to grow at a higher rate than some other more expensive alternatives such as subsea extraction. The movement from coal to gas fired power generation is another positive trend.

Oil Price Fluctuations

The coalescer market will increase by over 15 percent over the next four years if oil returns to $80/barrel. If it hovers around $40/barrel the market will only grow 8 percent (2%/yr) over the four year period.

![Effect of Oil Price on Coalescer Market 2015 - 2019](image)
McIlvaine will continue to assess the likely changes in oil prices based on the following factors:

- **The breakeven cost for a new well**
  - Hydraulic fracturing breakeven point is $30 to $50/barrel equivalent based on improved management practices and the extraction of more product from existing wells.
  - Oil and tar sands projects break even at $65/barrel.
  - Subsea is more expensive.

- **New Technology developments**
  - Bechtel experience with coal seam gas to LNG in Australia indicates lower break even costs than subsea extraction.
  - China coal to syngas and chemicals could be an alternative which is more than competitive at $40 oil. McIlvaine has recommended marrying the two stage (HCl/SO₂) scrubbing along with conventional hydrochloric acid leaching to extract rare earths and generate by product revenue.

- **Demand**
  - The slowdown in China could impact demand as could economic problems in Greece and other countries.
  - Demand is a function of industrial activity. There is little equipment needed to extract Saudi oil. On the other hand, over 2,000 companies rely on the Alberta oil sands market for their revenues. The greater the industrial activity the greater the oil demand.

- **Supply**
  - Saudi Arabia could choose to restrict production. In many ways the situation is analogous to the gold in Ft. Knox. You could sell it at any price and generate positive cash flow. However, it is a precious and finite resource which is important to future generations.
  - Market driven companies will typically be reactive rather than proactive and will only increase drilling after oil prices rise to a level to make drilling profitable.

- **Political developments**
  - Lifting the Iran embargo on oil exports.
  - Russian activities in the Ukraine and elsewhere.
  - Chinese efforts to manage the economy.
  - Uncertainties in North Korea, Greece and Venezuela.

- **Regulatory initiatives**
  - Export restrictions.
  - Climate change regulations.
  - Pollution control requirements for hydraulic fracturing.

- **Traumatic events**
  - Major oil spills.
  - Large meteorite impact, earthquake or major volcano eruption.
Top Purchasers

The coalescer market is concentrated due to the fact that ten oil and gas companies purchase more than half the coalescers. Two Chinese companies are the largest producers in oil and gas. Sinopec has revenues of over $450 billion/yr.

![Coalescer Cartridge Purchases by Largest Oil & Gas Companies](chart)

Large EPC firms are major purchasers. The top 10 oil and gas contractors account for 30% of coalescer purchasers. Note a portion of this total also is reflected in the purchases by the top 10 end users. The largest oil and gas contractors are:

1. Bechtel (USA)
2. Technip (France)
3. Aker Solutions (Norway)
4. Chiyoda Corporation (Japan)
5. SNC-Lavalin Group (Canada)
6. J. Ray McDermott (USA)
7. JGC Corporation (Japan)
8. Hyundai Heavy Industries (South Korea)
9. Foster Wheeler (USA)
10. Daelim Industrial Company (South Korea)

Design firms are also influential. Here is a ranking of the top 20:

1. AECOM (USA)
2. WorleyParsons (Australia)
3. ARCADIS (The Netherlands)
4. Furgo NV (The Netherlands)
5. Jacobs (USA)
6. WSP Parsons, Brinckerhoff (Canada)
7. Fluor Corp. (USA)
8. Dar Al-Handasah Consultants (Shair and Partners) (Egypt)
9. AMEC plc (UK)
10. CH2M Hill (USA)
11. TECHNIP (France)
12. SNC-Lavalin International Inc. (Canada)
13. Bechtel (USA)
14. Mott MacDonald Group Ltd. (UK)
15. Tecnicas Reunidas (Spain)
16. Arup (UK)
17. KBR (USA)
18. Atkins (UK)
19. Stantec Inc. (Canada)
20. Hatch Group (Canada)

The market for high efficiency cartridge coalescers in the oil and gas industry will see at least a 2% annual growth over the next five years. Natural gas provides an important part of overall energy usage. It undergoes a number of processes as it is transported from wellhead to end-user, and the proper filtration in each step will assure product quality and reduce equipment damage.