



PhaseSep® A/S Series Liquid/Liquid Coalescer

Effectively Separates Emulsions in
BioDiesel Process

Introduction

The PhaseSep® A/S Series coalescer is the latest member of Pall's PhaseSep coalescer family and is a high-efficiency phase separation element. Specifically developed for BioDiesel production processes, the PhaseSep A/S coalescer can help achieve critical separations at a lower cost, with better efficiencies and reduced process times than conventional centrifuges or settlers.

The polymeric coalescer media contains a tapered pore construction. The emulsion enters at the inside of the element and passes through a fine media layer that initiates the coalescing process by starting the enlargement of the dispersed phase droplets. Increasingly coarse media layers facilitate the passage of larger coalesced droplets before the fluid departs from the outside layer of the coalescer element completing the coalescing process.

The presence of difficult to separate emulsions can be costly and problematic for the BioDiesel producer. Inefficient separations of liquid contaminants can cause:

- Final products to be off-specification
- Excess consumption of expensive resins or increase in wash water volumes used for purification
- Costly processing delays
- Increased costs for wastewater treatment or disposal

Breaking stable emulsions can be a difficult task depending upon the process conditions and feedstocks used. Pall has developed a highly efficient coalescing element to enable separation of the stable emulsions typically found in BioDiesel production processes.

Important parameters in determining the ease of separating emulsions include: the interfacial tension (IFT), difference in density and viscosity. The IFT is a good way to assess the stability of an emulsion. For the very stable emulsions formed in BioDiesel processes, the IFT can be very low (<20 dyne/cm) and conventional separation technologies, including fuel product coalescers, can lose their efficiency when the IFT reaches below 20 dyne/cm.

Compatibility

Compatibility is also a key consideration when selecting a coalescer. Pall coalescers are available in a wide range of materials including various polymers and fluoropolymers.

The PhaseSep A/S Series coalescer is compatible with chemicals typically encountered in the BioDiesel process including: acids, caustics, and alcohols. For compatibility information with a specific chemical, please contact your local Pall office.



PhaseSep A/S Series Liquid/Liquid Coalescers shown

Part Numbers/Ordering Information

PhaseSep A/S Coalescer Element

LCS ● FPS ■ 00 (e.g. LCS1FPS200)

| Code | Length (nominal) inches /mm |
|------|--------------------------------|
| ● 1 | 10 / 254 |
| ● 4 | 40 / 1016 |

| Code | Removal Rating |
|------|-------------------|
| ■ 1 | Fine |
| ■ 2 | Medium |
| ■ 4 | Coarse |

Note: if hydrochloric acid is used for neutralization, use Pall's PhaseSep Y Series coalescer made entirely of polypropylene.

Typical Separation Applications

- Glycerin or glycerol from methyl ester
- Soap and water from washed BioDiesel
- Free fatty acid or methyl ester from crude glycerin
- Methyl ester from wash or wastewater

Performance of PhaseSep A/S Series Coalescers

- Typically remove free phase liquid contamination to a level of 50-350 ppmw based on gravimetric analysis
- Handle inlet dispersed liquid contaminant concentrations as high as 10% and greater¹
- Separate emulsions with interfacial tensions as low as 0.5 dyne/cm

Note: each application for the PhaseSep A/S Series L/L coalescer should be reviewed by Pall Corporation for technical feasibility.

Description of Coalescence

The Pall pre-filter and horizontal liquid/liquid PhaseSep coalescer system is shown in Figure 1 below. The first stage consists of a pre-filter housing that is used to remove solids from the inlet emulsion stream to protect the coalescer and ensure long service life. The pre-filter also functions as a pre-coalescer and starts the fine droplets in the emulsion on their route to forming larger intermediate drops that continue to enlarge in the coalescer medium.

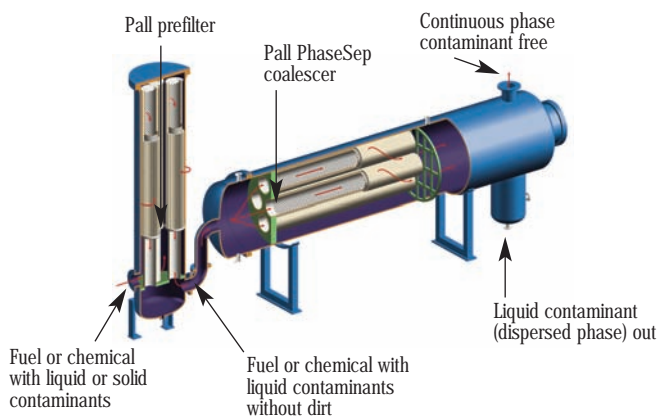


Figure 1: PhaseSep liquid/liquid separation system with coalescer elements in a horizontal housing.

For liquids with low (less than 20.0 dyne/cm) and ultra-low IFTs (less than 3.0 dyne/cm), a PhaseSep A/S coalescer installed in a horizontal housing will provide maximum liquid/liquid separation efficiency.

A Pall high-efficiency pre-filter should be installed ahead of the PhaseSep A/S coalescer to remove solids and ensure long service life.

- ¹ For applications greater than 2% dispersed liquid, the PhaseSep A/S Series horizontal housing will utilize two collection boots.
- ² Maximum temperature is 250°F (121°C) for most fluids, excluding strong acids. Pall suggests soak testing at higher temperatures. Note: element burst has not been evaluated for temperatures higher than 100°F (37°C).
- ³ Typically <2 psid for most applications. Can be higher due to increased viscosity or flow rate.

Product Specifications

Materials of Construction

| | |
|---------|----------------------|
| Core: | 316L stainless steel |
| Medium: | Proprietary polymer |

Performance Claims and Specifications

| | |
|---|--|
| Maximum temperature: ² | 250°F (121°C) |
| Recommended change-out: | 15 psid (1.03 bard) |
| Maximum differential pressure rating: | 30 psid (2.07 bard) @ 100°F (37.8°C) |
| Initial pressure drop for the two applications in the table below | <2 psid (0.14 bard) ³ |
| Typical flow rate for coalescing glycerin from methyl ester: | 3-4 gpm (11-15 lpm) per 40" coalescer. Part #LCS4FPS100. |
| Typical flow rate for coalescing water from washed BioDiesel: | ~1 gpm (3-4 lpm) per 40" coalescer. Part #LCS4FPS100 |

PhaseSep A/S Coalescer Systems

Pall's PhaseSep A/S coalescer elements are assembled with an adapter (see Figure 2) and are installed in horizontal housings.

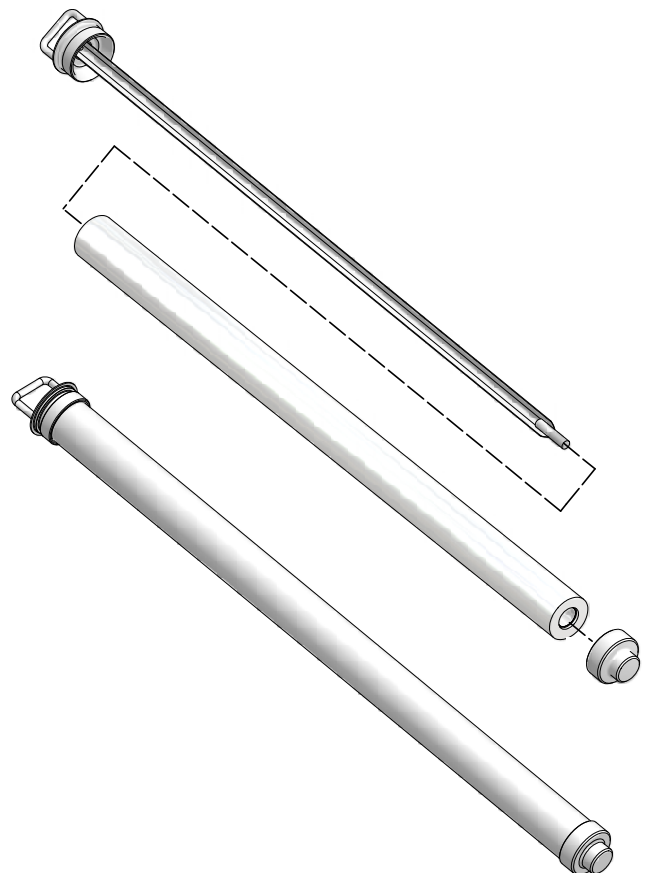


Figure 2: PhaseSep coalescer assembly diagram

Trial Ordering Information – Coalescer

| Part Number | Description | Nominal Diameter | Nominal Length |
|----------------|-----------------------------------|-------------------|------------------------------|
| LCS ● FPS ■ 00 | PhaseSep A/S Series L/L coalescer | 2.5 in. (63.5 mm) | 10" (254 mm) / 40" (1016 mm) |

| Code | Length (nominal) inches /mm |
|------|-----------------------------|
| ● 1 | 10 / 254 |
| ■ 4 | 40 / 1016 |

Trial Ordering Information – Adapter

| Part Number | Description | Nominal Length |
|-------------|----------------|----------------|
| T949944010 | 1" NPT Adapter | 10" (254 mm) |
| T949944000 | 1" NPT Adapter | 40" (1016 mm) |

| Code | Removal Rating |
|------|----------------|
| ■ 1 | Fine |
| ■ 2 | Medium |
| ■ 4 | Coarse |

Use 10" adapter with 1" NPT connection for pilot or trial tests. 40" adapter with 1" NPT connection can also be used in 4" pipe run for trial or pilot. The PhaseSep A/S coalescer has been extensively tested in applications with nearly 100% success. For information specific to evaluating PhaseSep A/S elements with your process, please contact your local Pall office.

Note: Pall Scientific and Laboratory Services (SLS) can be contracted for detailed on-site PhaseSep A/S coalescer trials and piloting services. Please contact your local Pall office to learn more about how Pall can help evaluate your process and develop separation solutions specific to your operating conditions.

PhaseSep A/S Coalescers – Developed Specifically for BioDiesel Processes

| Feature | Benefit |
|--|---|
| <ul style="list-style-type: none"> • Polymeric medium construction with 316L stainless steel core | <ul style="list-style-type: none"> • Wide fluid and chemical compatibility including: methyl ester, methanol, catalyst, and acids (except HCl) • High temperature compatibility • Performance not impaired by presence of surfactants • High-efficiency liquid and particulate contaminant removal reduces incidents of off-spec product, saving on reprocessing, downgrade, and transportation costs • Withstands upsets or emulsion variability due to process changes |
| <ul style="list-style-type: none"> • Non-disarming medium | <ul style="list-style-type: none"> • Specially formulated medium contains no glass fiber and does not disarm in the presence of surfactants • Enhanced performance of downstream equipment |
| <ul style="list-style-type: none"> • Tapered pore structure with high void volume medium | <ul style="list-style-type: none"> • Ensures the longest possible service life • Low pressure drops in service • Can separate liquids that have low interfacial tension |
| <ul style="list-style-type: none"> • Excellent coalescing properties | <ul style="list-style-type: none"> • Separation of ultra-low IFT emulsions that typically cannot be separated by conventional methods • Highly efficient emulsified droplet capture resulting in excellent fluid quality |
| <ul style="list-style-type: none"> • Unique adapter design | <ul style="list-style-type: none"> • Results in an overall smaller assembly size with less material to be disposed of when changing elements • Reusable adapter installed through the horizontal housing's tubesheet and seals with an O-ring |
| <ul style="list-style-type: none"> • Low energy input | <ul style="list-style-type: none"> • Low cost liquid separation compared to less efficient methods (settling or energy intensive equipment such as centrifuges and distillation) |
| <ul style="list-style-type: none"> • Small footprint | <ul style="list-style-type: none"> • Reduced settling time and space |
| <ul style="list-style-type: none"> • Low disposal and maintenance costs | <ul style="list-style-type: none"> • Long useful life of the PhaseSep A/S elements, especially when using Pall's pre-filter, results in fewer element change-outs, reduced maintenance, and disposal expenses |

Pall Corporation – A Leader in Separation Technologies

For over 60 years, Pall Corporation has been solving complex contamination, separations, and purification problems for diverse customers around the world. With revenues of \$2.6 billion in fiscal year 2008, Pall is the largest and most diverse filtration, separations, and purifications company in the world. Pall Corporation is committed to advancing technologies that create value for our customers. One of our focuses is on process efficiency increases that enable the renewable and alternative energy markets. This demonstrates Pall's leadership for "Enabling a Greener Future" by providing global solutions that maximize the potential for reducing the world's reliance on petroleum.

Pall offers a full range of scalable products and services for the BioDiesel industry. For more than a decade, we've helped producers and technology providers evaluate processes and have developed separation solutions that streamline production, increase yields, and help improve product quality.

One main application of interest in the industry is to increase the efficiency and throughput of the critical glycerin/glycerol separation step. Pall's high-efficiency coalescer systems, developed specifically for BioDiesel production, can help achieve this goal at a lower cost with better efficiencies and reduced process times than centrifuges or settlers.

Pall works directly with you to develop a personalized Total Fluid ManagementSM solution, enabling valuable economic process improvements with services that improve your system's operations. With this program, you'll receive unequalled technical consultation and support from our Scientific and Laboratory Services department, an extensive global network of scientists and engineers who are experts in their field.

Partner with Pall and let our experts solve your separation challenges!




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