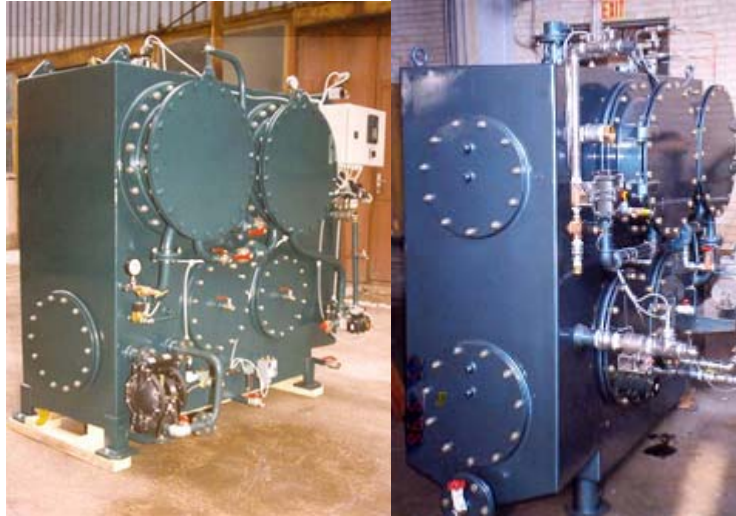




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## **THE GENOIL CRYSTAL OIL/WATER SEPARATION SYSTEM**



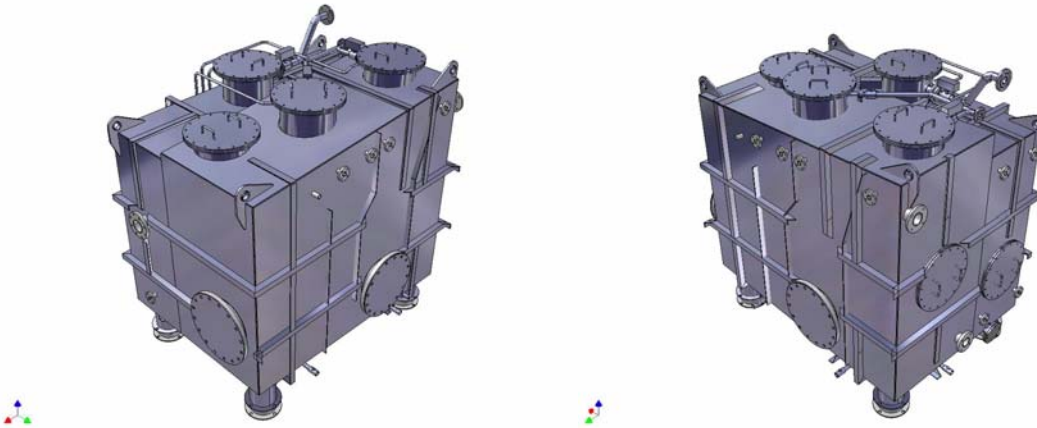
### **DESCRIPTION**

The Genoil Crystal 2-phase oily water separation system was developed to clean a water stream to discharge specifications. At present, refiners use API ponds where the first section utilizes gravitational separation aided by floating oil skimmers to recover oil that is sent to a slop oil tank. This slop oil is then reprocessed in the refinery as a slipstream. The second section of the API pond is primarily a biological process made up of one or two ponds where air is added by either perforated piping or aerators for the bacteria. The HRT is typically anywhere from 30 to 45 days. In this application there would be potential for the Crystal system in order to substantially improve the overall efficiencies of this process, especially when real estate is at a premium.



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### 3D DRAWINGS



The Crystal 2-phase oily water treatment units are designed to separate the liquid phases in six stages located within a single vessel. Each stage is devised to remove oil particles of a certain size and renders the liquid cleaner for the next stage. This ensures greater effectiveness and manageable loads for each stage. Furthermore, it also precludes undue contamination and clogging of various stages by oil, resulting in trouble free-operation.

Minute gas bubbles resulting from controlled vacuum conditions enhance the removal of oil droplets from the water stream. Vacuum is created in stages operating prior to the circulation pump. Oil is retained at the upper portion of the stages and is gradually accumulated in collection zones.

Downstream from the pump the stages are slightly pressurized. Oil extracted in these stages is transferred continually into the collection zones through specially designed conduits. The transfer of oil occurs due to the pressure differential existing between the stages located upstream and downstream from the pump respectively. Continual oil extraction ensures outstanding cleanliness of the polishing stages and prevents accidental contamination of the effluent.

Oil accumulation in the collection zones is monitored by a probe that initiates periodic oil discharge sequences. The separator is isolated from the discharge line and connected to a pressurized line. Clean water back-flushes the stages and displaces the oil from the collection zones. The oil probe resumes the separation process after a preset amount of oil is evacuated.



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The first stage achieves oil-water separation through gravity enhanced by a flotation effect of minute gas bubbles. Most of the oil droplets are removed in this stage. The flow is reversed prior to the liquid entering the second stage. This assists in leaving the oil behind in the primary collection zone. Sludge and other contaminants denser than water are deposited at the lower portion of the first stage.

The second stage achieves oil-water separation by coalescence. A perforated chamber accommodates suitably sized oleophilic beads. An arrangement designed to agitate the liquid and allow free movement of the beads enhances the coalescing effect and also a self-cleaning process. As a result, oil droplets adhering to adjacent beads are readily brought together. Larger drops formed in this fashion overcome the force of attraction exerted by the beads. As a result they leave the beads and migrate toward the oil collection area. The rubbing action occurring between the beads in motion releases solid contaminants, thus cleansing the beads.

An oil layer formed within the chamber absorbs small hydrocarbon particles in order to break down emulsified oil. The thickness of the oil layer is self-regulating. As the liquid enters the third stage the coalescing process is resumed. Smaller oil particles reaching this stage are dealt with in a similar fashion by optimally sized beads.

A pump draws the liquid from the third stage and pumps it into the fourth stage for further separation by means of a vortex-generating device. Centripetal forces within the vortex agglomerate the oil particles and force them to coalesce in order to form larger globules. Furthermore, an effect similar to one created by a cyclone also agglomerates the oil particles thus enhancing the coalescing process. A perforated pipe retrieves the globules that migrate toward the eye of the vortex and directs them to a dispersion plate placed above the vortex generator. Oil particles then travel through suitably sized perforations in the dispersion plate, gather around a funnel and migrate toward the oil collector of the second stage.

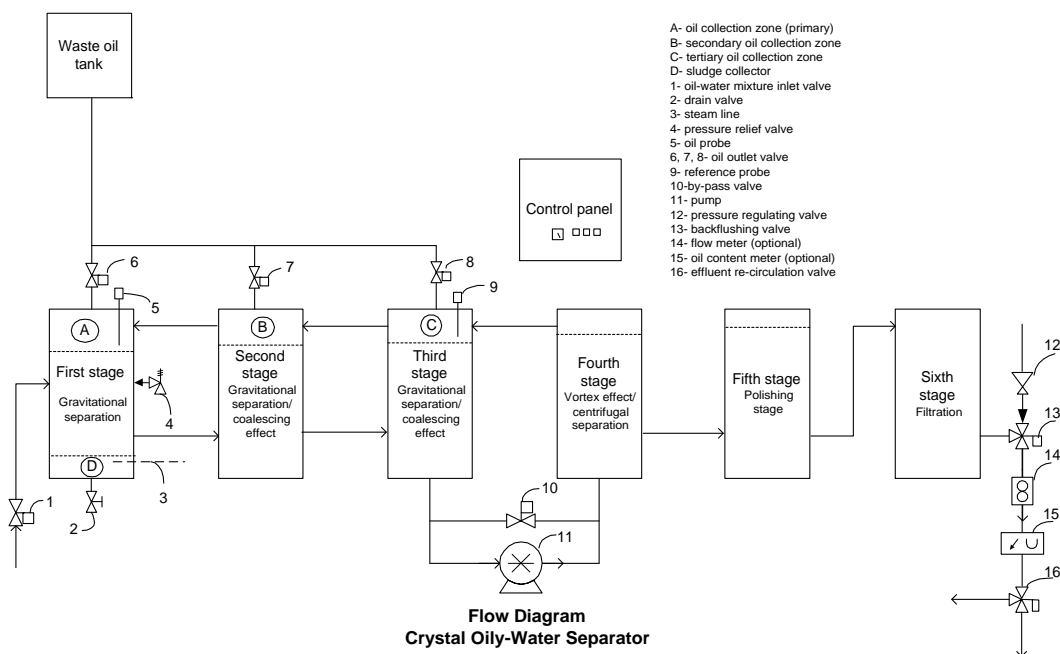
Spinning liquid rapidly exits the vortex generator, being deflected downwards by the dispersion plate for separation by gravity. Further separation of minute oil particles occurs in the fifth stage by means of an electro-static field. Thus the oil particles are forced to form clusters of larger globules, which are readily left behind as the flow is reversed and reaches the fifth stage polishing. In most cases the separation is completed prior to this stage. However, for oils of very high density the sixth stage retains the remaining particles by means of filters. The filter media are designed to coalesce minute particles of oil on their surface. Enhanced buoyancy by coalescence and the sweeping effect of the liquid take away the oil particles from the filter media. Thus filter media lifespan can be prolonged to significant periods of time. This is due to minimizing the amount of oil particles reaching the media and effective oil removal from the surface of the media.



When continual operation is required a positive displacement pump evacuates the oil while the separation process is taking place. An oil content meter may monitor the quality of the effluent. In the unlikely event the oil content exceeds 15 mg/l, a re-circulation valve isolates the unit from the discharge line. The effluent is then re-circulated to the inlet line and reprocessed in the separator until it meets the requirements.

The main advantage of a Crystal is the nesting design. The four separation principles (gravity, coalescing beads, vortex, filter) employed in this design are simple, and have no moving parts. With the nesting design, Crystal is a very compact unit that is ideal for tight quarters. It was originally designed for the bilge area of a ship. The order used in the separation principles is key to reduced maintenance and effectiveness. The bulk of the oil is removed in the stages prior to filtration. A pump is located between the third and fourth stage, and since the bulk of the oil has been removed, emulsions are much less of a problem than if a pump was placed up front of the unit. The filter is the last stage. Of course the filter has to be changed when it is clogged. However by having five stages in front of it, the filter does not receive a lot of oil and therefore would not require frequent changes. The unit can also be run without the filter, virtually eliminating maintenance.

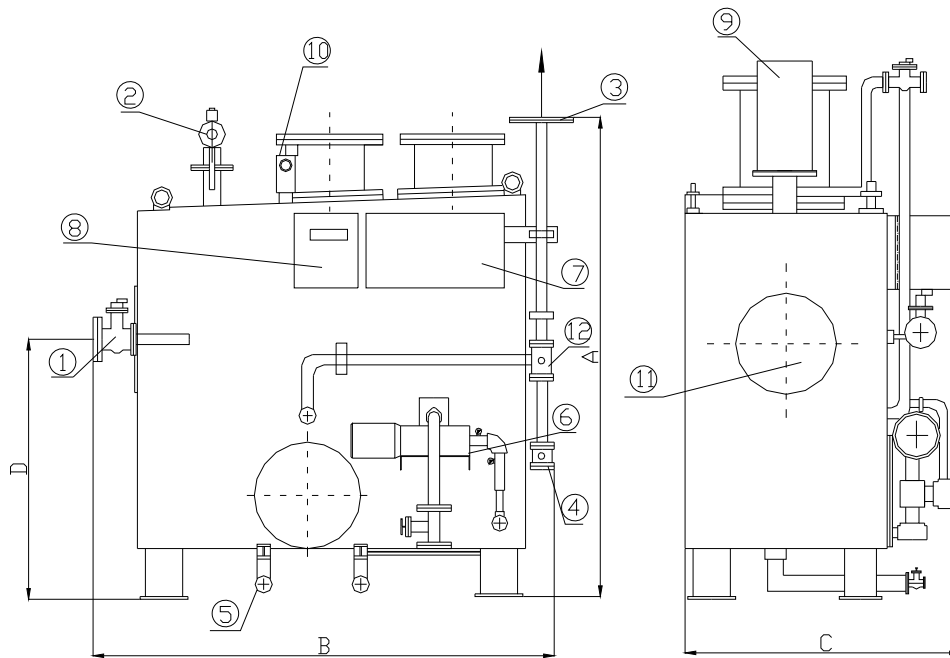
### PROCESS FLOW DIAGRAM





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## MAIN FEATURES AND APPLICATIONS



1. Oily-water inlet
2. Oil outlet
3. Effluent outlet
4. Back flushing line
5. Drain
6. Pump
7. Control panel
8. Oil content meter
9. Oil probe, 1st stage
10. Oil probe, 2<sup>nd</sup> stage
11. Lid
12. 3-way valve

Electrical supply : 380 VAC / 3 phase / 50Hz  
440 VAC / 3 phase / 60 Hz  
220 VAC / 1 phase / 50 Hz  
115 VAC / 1 phase / 60 Hz

Compressed air supply: 600-800 KPa  
Back flushing water pressure: 100-200 KPa



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## Main Features

- ❑ **Unique six-stage design for enhanced efficiency and performance**
- ❑ **No limitations on oil particle size**
- ❑ **Handles emulsions and oils with very high densities**
- ❑ **Low downtime, maintenance and operating costs**
- ❑ **Compact design for portability and applications where space is at a premium**
- ❑ **Simple and reliable operation**
- ❑ **Versatility for a wide range of applications**
- ❑ **Quality service and assistance for specific applications**

## Applications:

- ❑ **Sand-washing plants, recycling of condensed steam in oil batteries, refineries**
- ❑ **Oil platforms**
- ❑ **Thermal power stations**
- ❑ **Wastewater treatment plants**
- ❑ **Reclaiming emulsified oil in steel mills**
- ❑ **Bilge water separation aboard sea-going vessels**
- ❑ **Gasoline/Diesel service stations**
- ❑ **Cement factories**
- ❑ **Salt mines**

Genoil Crystal oily-water separators utilize a patented, unique process for multi-stage separation of immiscible phases with different densities such as mineral or vegetal oils and water, animal fat and water etc. An innovative separation process combines gravitational and centrifugal forces with surface tension and vortex effects prior to the polishing stage. A highly effective polishing stage enhances performance and minimizes maintenance costs and downtime.

There are no limitations on oil particle size, and Crystal separators feature a method for braking down emulsions. Thus emulsified oil utilized in steel mill processes is reclaimed and recycled with considerable savings. Sludge and solids are collected at the bottom of the first stage, which, in some applications can be fitted with Genoil patented fluidizing devices to facilitate disposal.

Through superior efficiency and engineering the separators are compact and easy to install wherever space is at a premium. The tank module is precision built, meeting or exceeding the rigorous specifications of classification societies. Separators installed aboard ships have been certified by Germanischer Lloyds and Registrul Naval Roman (Certificate Nos. 32451BUC/27.06.96 and 17/I/3425-DR, respectively). Each unit is tested prior to delivery for complete customer satisfaction and all tests are conducted in accordance with I.M.O. Resolution A.393 (X) / MEPC 60(33).



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The automation system ensures unattended operation and features PLC units, self-cleaning oil sensors, and other fail-safe components. The automation is also user-friendly for convenient operation and includes carefully selected components. In custom-built units Crystal can be integrated into complex automation systems being operated and monitored from a central location.

Explosion-proof automation (Class I Div. I) for the oil industry is available upon request. Our team provides technical assistance in special applications, guarantees quality service and helps clients with the installation of larger units. The separators can be custom engineered to suit specific requirements from 600 to 50,000 liters/hour capacities.

Crystal separators typically achieve effluent purities of less than 5 mg/l for 0-100% oil in water mixtures and relative oil densities of up to 0.97. In some applications oil content in the effluent is consistently below 2 mg/l at ambient temperature. In very demanding situations with hydrocarbon densities as high as 0.985 the purity can be reduced to 8 mg/l.

In some US navy and army bases Crystal separators operate in conjunction with Anjan filtering units devised to remove dissolved contaminants. When used in conjunction with Anjan, the effluent purity was below 0.1 mg/l, which is virtually undetectable.



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## SPECIFICATIONS

Model	Capacity [liters per hour]	A Height [mm]	B Length [mm]	C Depth [mm]	Inlet Line [inch]	Effluent Line [inch]	Oil Outlet [inch]	Power [kw]	Weight [kg]
IU 0.6 MU 0.6	600	1300	950	450	3/4	3/4	3/4	0.75	250
									265
IU 1.25 MU 1.25	1250	1450	1160	500	1	1	1	1	450
									475
IU 2.5 MU 2.5	2500	1600	1400	750	1 1/4	1	1	1.5	900
									950
<i>IU 5</i>	5000	1900	1900	900	2	1	1	3	1450
									1530
<i>MU 5</i>									
IU 10	10000	1900	2100	1200	4	1 1/2	1 1/2	5	2900
IU 20	20000	1900	2200	1600	6	3	2	7.5	4800
	50000	2200	2400	1900	8	4	2	15	9600
<i>IU 50</i>									

IU-industrial use. MU- marine use Specifications subject to change without notice





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## PARTIAL LISTING OF INSTALLATIONS AND TESTIMONIALS

Several Crystal units were installed in different locations around the world before Genoil acquired the technology.

OWNER	APPLICATION	CAPACITY [LITERS/HOUR]	QUANTITY	INSTALLATION DATE
Boyd T. Keogh & Associates Manley, Australia	Units are operated in conjunction with Anjan filtering equipment for processing industrial wastewater.	5000	2	1995
		600	1	1995
Enviremedial Services Inc. Vista, California U.S.A.	Separators operate upstream Anjan filtration units for processing wastewater at the U.S. Army base of Camp Pendleton.	600	1	1995
		1250	1	1996
		5000	1	1996
		1250	1	1998
		2500	1	1998
		5000	1	1998
Hydroxyl Inc. Sidney, B.C. Canada	Unit installed upstream oxygen-based decontamination plant.	1.250	1	1996
Oil Terminal S.A. Constanta, Romania	Unit processes ballast oily-water from tankers for disposal to sewer.	50000	1	1997
Administratia Cailor Navigabile S.A. Constanta, Romania	Bilge separators installed aboard ships.	600	1	1997
		600	2	1998
Santierul Naval Oltenita S.A. Oltenita, Romania	Unit processes storm water for disposal to sewer.	1250	1	1998



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<b>OWNER</b>	<b>APPLICATION</b>	<b>CAPACITY [LITERS/HOUR]</b>	<b>QUANTITY</b>	<b>INSTALLATION DATE</b>
U.S. Navy Coronado, California, U.S.A	In conjunction with Anjan filtering equipment Crystal processes contaminated water in a car wash station.	1250	1	1999
CE3 Technologies Inc. Edmonton, Alberta Canada	Units installed in a water treatment plant in conjunction with Anjan and Alfa Laval distillation plants designed to process produced water into pure distilled water.	20000	4	2000
Centrala Electro Termica Progresul S.A. Bucharest, Romania	Owned by the Romanian Government, the power plants employ Crystal units for processing water contaminated with heavy fuels and bottoms for disposal to sewer.	20000	2	2003
Ispat Sidex S.A. Galati, Romania	Units reclaim emulsified oil resulted from steel mill cooling/quenching processes and recycle the oil with important savings.	10000	2	2003
Centrala Electro Termica Iasi S.A. Iasi, Romania	Application similar to the one at Bucharest power plant.	10000	2	2003
Centrala Electro Termica Sud S.A. Bucharest, Romania	Application similar to Bucharest power plant.	20000	2	2003-2004



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## TESTIMONIALS

*“As the wastewater manager for Fort Bliss I encountered extraordinary water management issues that seemed to defy any easy solution. Your plant was placed in operation within 30 minutes and was able to treat the worst oil-water sludge from our oil-water separator processes to below EPA effluent discharge standards. I know for a fact that all military representatives who were present at your demonstrations were highly impressed. In my opinion, there are several important reasons why your technology represents a breakthrough and, therefore, represents great value to the Federal Government, particularly for military bases facing closure: 1) speed of set-up and ease of performance; 2) ESI’s offer to provide a service-based contract to get the job done on a guaranteed basis; and 3) high performance at an extremely competitive cost. We were so impressed with ESI’s performance that I will make it a point to relay information about your technology to my counterparts at other military bases. You can expect a list of these contacts at the first of the year. What you have done is of outstanding value to the Government and to our country in general. Let me know if there is anything I can do to help.”*

Michael Landis  
Wastewater Manager  
Fort Bliss, Texas

*“Our company was interested in operating mobile water treatment systems and an intricate part of that was the removal of oil from water down to very low parts per million in the effluent. Crystal was the only system we found that could give us the desired results and be suitable to be moved about in a vehicle. We first used this system in two plants, sold to the Royal Thai Government. We have since purchased other units and have been very satisfied ever since. Our satisfaction not only came from the quality of the product but the level of service and commitment from Mr. Costinel. His first thought was always the satisfaction of the customer and how well his separators service the customer needs.”*

Chris Keogh,  
CEO Enviremedial Services Inc.

*“Mr. Costinel’s unique invention is complementary to my company’s patented equipment, and we have imported his Crystal Oil/Water Separator as an integral part of our plants, for use both in Australia and overseas. Mr. Costinel’s attention to detail and insistence on a high and reliable level of service plus the quality of his product make it a pleasure to deal with him.”*

Boyd T. Keogh,  
President Boyd T. Keogh and Associates.