Enviro Voraxial® Technology

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Case Study
Voraxial® 4000 Separator
On Offshore Platform
For Pretreatment of Produced Water

Summary

This Case Study summarizes the installation of a Voraxial® 4000 Separator on an offshore platform for separation of produced water and improvement of the customer's existing treatment system. The Voraxial® Separator was installed to do bulk oil separation to improve the discharge water quality from a holding tank and to reduce the amount of produced water being pumped onshore for treatment.

Other characteristics of the platform that influenced the customer to use the Voraxial are the limited space and low pressure of the fluid stream (less than 30 psi). The Voraxial provides efficient separation without a need of a pressure drop and processes a high volume with a small footprint.

The offshore platform is producing approximately 21,000 barrels per day (BPD) of produced water. Due to the high volume and high oil content of the produced water stream, the offshore treatment system was inefficient to meet discharge requirements, forcing the customer to pump the total fluid stream back onshore for treatment. The Voraxial 4000 Separator was installed upstream of the customers produced water system to increase the separation efficiency of the offshore system so that the fluid stream can be discharged instead of being pumped onshore for treatment. A sidestream of the total flow was diverted through the Voraxial 4000 Separator. Since the installation, the customer has been able to meet discharge requirements on the fluid stream processed through the Voraxial. Currently, the Voraxial 4000 Separator is processing 13,000 BPD.

The application of the Voraxial 4000 Separator for pretreatment has resulted in efficient separation of the oil. Without the Voraxial Separator, the efficiency of treatment for removal of Total Petroleum Hydrocarbons (TPH) was 73%. With the Voraxial Separator as a pretreatment device, the system has over 93% removal efficiency.

Voraxial Description

The Voraxial Separator is a compact, light-weight, continuous flow separator that simultaneously separates liquid/liquid, liquid/solid, or liquid/liquid/solid flow streams. The Voraxial is fitted with a low shear, non-clogging impeller designed to create a cyclonic flow. By this action, the heavier materials, i.e. solids, are forced to the outside of the vortex while lighter materials such as oil are drawn to form a central core of the vortex (see Figure 1 below). A specially designed manifold at the exit of the separation chamber is utilized to collect the separated streams.

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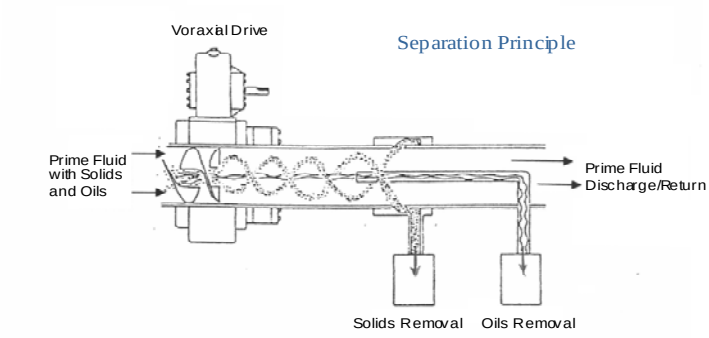
Figure 1



Unlike other separation equipment, the Voraxial does not need a pressure drop to produce a good separation. In fact, the unit actually operates like a pump (axial flow type). The Voraxial is able to efficiently separate slugging of oil and a fluctuation in flow rate.

To produce efficient separation, the Voraxial Separator is capable of generating a high "G" force. The Voraxial Separator is scalable and can be fabricated to process virtually any amount of flow. EVTN presently manufactures four (4) models. These models are listed on Table 1 along with nominal flow rates.

Model Voraxial® 4000 Separator. As shown on this figure, the separator has a very small footprint (this separation chamber has a 4" diameter), while processing high flow rates.

Table 1
Voraxial® Separator Models

Model	Separation Chamber Diameter (Inches)	Nominal Flow (GPM)
Voraxial 1000	**1**	**5**
Voraxial 2000	**2**	**15 – 60**
Voraxial 4000	**4**	**100 – 500**
Voraxial 8000	**8**	**1000 – 6000**

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The flow rates listed on Table 1 are nominal rates for typical conditions encountered. The units can operate outside these ranges, depending on the Voraxial® Separator operating speed, and inlet and outlet flow conditions.

Project

An offshore platform customer in the Caribbean produces approximately 21,000 BPD of produced water. Presently, the fluid stream is being pumped back to shore for treatment as the volume and oil concentration are too high for their existing system to be effective.

The Voraxial 4000 Separator was installed to do the bulk oil separation prior to discharge to a holding tank to improve the water quality efficiency. The design specifications for the Voraxial 4000 Separator are shown below.

Design Specifications

Nominal Flow Rate	100-500 gpm (3000 - 17000 BPD)
Design Pressure	250 psi
Design Temperature	250 F
Construction Materials	316 SS
Pipe Size	4 Inch
End Connections	150# RF Flanges
Valves	316 SS Ball Valves
Instruments	Pressure Gauges
Electrical	460 V, 3 Phase, 60 Hz
Voraxial Power	25 Hp
Nitrogen/Air Requirements	10 SCFM
Design Rotational Speed	6000 RPM
Maximum “G” Force	2000
Approximate Weight (empty)	1350 Kg
Dimensions (L X W X H)	5000 X 1200 X 1200 mm

The Voraxial Separator has been operating on the platform since October 2008. The Separator was installed to treat a sidestream of the produced water. The flow to the Voraxial Separator ranges from 4,500 to 13,000 BPD of the total 21,000 BPD of produced water.

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Data collected during December 2008 and January 2009 is shown on Table 2.

Table 2
Pretreatment of Produced Water

Date	Flow (BPD)	Inlet TPH (ppm)	Voraxial Outlet TPH (ppm)	Voraxial TPH Removal (%)	V203 Outlet TPH (ppm)	System TPH Removal (%)
12/2/08	4,000	1,197	-	-	326	73
	4,500	1,151	97	92	45	96
	NR	778	368	53	39	95
12/3/08	6,000	1,617	354	78	98	94
	6,000	787	242	69	80	90
12/4/08	6,500	958	314	67	105	89
	NR	786	292	63	87	89
12/5/08	6,500	879	375	57	90	90
	6,500	993	370	63	63	94
	6,500	682	178	74	61	91
12/6/08	7,000	1,533	247	84	37	98
	7,000	715	91	87	44	94
	7,000	635	217	66	67	89
12/7/08	6,000	524	106	80	71	86
	6,000	696	183	74	56	92
12/8/08	6,000	626	191	69	54	91
	6,000	433	326	25	76	82
12/9/08	6,000	733	117	84	67	91
12/10/08	6,000	471	83	82	27	94
1/7/09	12,000	379	144	62	69	82
	12,000	697	243	65	38	95
1/12/09	13,000	1,312	203	85	46	96
1/15/09	13,000	770	135	83	42	95
	13,000	NR	141	N/A	38	N/A
	13,000	1209	153	87	35	97
1/16/09	13,000	1361	140	90	42	97
	13,000	655	198	70	56	92
	13,000	671	176	74	45	93
1/17/09	13,000	693	168	76	46	94
	14,000	NR	NR	N/A	78	N/A
	13,000	762	146	81	38	95
1/18/09	13,000	625	148	76	52	92
	13,000	689	152	78	42	94
	13,000	638	156	76	46	93

NR – Not Recorded

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V203 listed in the table is the designation for the holding tank which receives the discharge from the Voraxial Separator. The "System" refers to the Voraxial Separator followed by the holding tank.

The use of the Voraxial Separator for pretreatment has good results. As shown on the table, the influent Total Petroleum Hydrocarbon (TPH) concentrations ranged from about 400 ppm to over 1,600 ppm. Without the Voraxial Separator, the efficiency of treatment for removal of TPH was 73%. With the Voraxial Separator as a pretreatment device, the system has over 93% removal efficiency. Outlet concentrations from the System with the Voraxial Separator ranged from a low of 27 ppm to a maximum of 105 ppm.

The results also show that the Voraxial separation performance was not affected by a wide change in flow (from a flow of 4,500 BPD to a flow of 13,000 BPD) or influent concentration (over a range of approximately 4 to 1).

Conclusion

The Voraxial 4000 Separator is presently operating on a platform in the Caribbean. The Separator is providing pretreatment for produced water to improve the water quality for discharge. The application of the Voraxial 4000 Separator for pretreatment has resulted in efficient separation of the oil. Without the Voraxial Separator, the efficiency of treatment for removal of Total Petroleum Hydrocarbons (TPH) was 73%. With the Voraxial Separator as a pretreatment device, the system has over 93% removal efficiency.