

Advantages of point source reduction of oils and hydrocarbons in refining and petrochemical operations

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The traditional approach to wastewater treatment in refineries and petrochemical plants is to discharge wastewaters from almost all sources into a common sewer system. The blended wastewater is then treated at a central wastewater treatment plant (CWWTP). While this has been a satisfactory approach in the past, a modern plant must use a different approach to most economically achieve the current Environmental, Health and Safety (EH&S) standards, wastewater discharge criteria, and water recycle objectives.

In a refinery or petrochemical plant, wastewater is generated in a number of process units or other point sources, including desalters, sour strippers, degassers from isomerization units, cracking quench processes, stormwater, boiler condensate, cooling water blowdown, and washwater drains. The volumes and characteristics from each of these point sources vary widely, though the dominant contaminant is usually oil or other hydrocarbons including BTEX compounds, polyaromatics (PAHs), gasoline range organics (GRO), diesel range organics (DRO), light fuel condensates, tar, coke, asphaltenes, creosotes, and other low molecular weight chain hydrocarbons. Table 1 presents typical hydrocarbon concentrations from various point sources in a petrochemical plant. The concentration of these compounds in the sewer system and the CWWTP most often define employee exposure issues, CWWTP effluent quality, and water recycle economics.

Clearly from this data, the highest concentrations of oils and organics often occur in only a few of the streams. Contributions from these few streams produce the problematic concentrations in the sewer or drain system and the CWWTP, affecting the plant in a variety of ways.

Table 1 - Examples of oil and hydrocarbon contamination ranges in some refining and petrochemical processes

Wastewater Sources	Oil/Hydrocarbon Contamination Ranges
Isomerization units	50 - 10,000 ppm
Olefin cracking quench tower	3,000 - 5,000 ppm
Sour stripper	5 - 300 ppm
Desalters	30 - 5,000 ppm
Stormwater/AOC	300 - 500 ppm
Firefighting training centers	50 - 1,000 ppm
From tank wash or catalytic cleaning operations	5 - 100 ppm
Cooling water (when there is an oil leak in heat exchangers)	5 - 100 ppm
Boiler condensate (when there is an oil/hydrocarbon leak in heat exchangers)	3 - 50 ppm

Many of the hydrocarbons may be toxic, noxious, or may produce toxic vapors upon reaction in the sewer system; workers may therefore face exposure risks far from the source. Almost all of the hydrocarbons are flammable; a fire or explosion hazard may be created in the sewer system or specific units of the CWWTP. The degradation of some of the hydrocarbons may result in corrosive byproducts, potentially damaging the collection system or CWWTP. Some of the hydrocarbons may not be readily treated in a conventional CWWTP, resulting in non-compliant discharge to the environment. And finally, the

presence of a few specific hydrocarbon constituents, or high levels of hydrocarbons in general, may make the difference between a water recycle initiative that is economically viable and one that is not.

The installation of a small point source treatment system can dramatically reduce or eliminate all of these issues by localizing the EH&S hazards at the source and by avoiding costly improvements to the CWWTP.

Consider the specific example presented in Table 2. If the oil and hydrocarbons from the degasser drain are removed before the wastewater is discharged to the sewer system, the entire 21 - 41 m³/h water feeding the CWWTP will have less than 1 ppm oil content, just by installing a 1 m³/h gpm point source treatment system.

Table 2 - Process wastewaters from a typical Methanol/MTBE production process

	Flow Rate (min-max)	HC Concentration Without Point Source Treatment	HC Concentration With Point Source Treatment
Process wastewater from degasser drain in isomerization units	1 m ³ /h	50 -10,000 ppm (widely fluctuating)	< 1 ppm
Process wastewaters from all other sources within the facility	20 - 40 m ³ /h	< 5 ppm	< 1 ppm
Total process wastewater from the facility entering the CWWTP	21 - 41 m ³ /h	5 - 350 ppm	< 1 ppm

A point source contamination reduction approach has not been common in most refining and petrochemical facilities. This has been primarily because the operational and space requirements of conventional oil/water separation equipment have not been compatible with the environment of a process unit. Other common limitations of traditional oil and hydrocarbon removal devices like API/CPI separators, float cells, biological treatment, chemical treatment, membrane filtration, and carbon- or clay-based adsorbent systems in regard to point source contamination removal are:

- Performance gap or limitations. The devices are sensitive, i.e. not robust to process upset conditions. While some devices can only remove free oil, others cannot handle free oils. Likewise, other devices remove some emulsified oils, but get fouled with free oils and most of them also cannot handle too much oil or solubilized oils.
- Non-viable economics due to frequent process upset conditions, which is bound to happen in a production process intermittently.



A 10 m³/h MyCelx oil removal system discharges oil-free water from a process wastewater tank into a drain



A 1,200 m³/h MyCelx oil removal unit

• More hazardous waste or toxic byproducts for disposal, leading to handling risks and safety issues.

The above limitations can be overcome by incorporating a technology or device that can add robustness to the performance of the traditional devices, thereby making the treatment process economically viable for point source treatment and recycle.

MyCelx™ oil removal technology in Saudi Arabia

MyCelx oil removal systems are one such proven and viable option for point source oil contamination removal and water recycle. For instance, a MyCelx oily water treatment plant is treating process wastewater generated at an isomerization condensate unit at a petrochemical facility in Jubail, Saudi Arabia. With a flow capacity of 1 - 10 m³/h, the system consists of a MyCelx Solu-Break Injection (De-emulsifier), a 4-stage Advanced Coalescer, and a MyCelx Polisher. The system meets discharge requirements of less than 1 ppm oil in water, with an inlet concentration of oil between 50 – 10,000 ppm.

The process wastewater contains both free and soluble hydrocarbon components like BTEX, kerosene range, jet fuel range, diesel range, gasoline range, tar, asphaltenes, creosote, etc. Effluent oil in water from the MyCelx Polisher unit is less than 1 ppm (well below the requirement), while effluent BTEX from the MyCelx Polisher unit is less than 3 ppm. Waste generation is 95% pure condensate reusable product and spent MyCelx polisher cartridges reused as fuel in an incinerator.

The Saudi end-user has seen several benefits to using the MyCelx system. The system, which is operational 24/7, has eliminated VOC emissions and hazardous odor from the wastewater drains, trenches and collection sump. It has reduced oil content in water entering the CWWTP to less than 5

ppm oil, rather than 100 - 500 ppm (without the system). With the MyCelx system, the end-user is able to produce about 165,000 m³/yr of oil-free process water that can be recycled or reused locally.

Summary

Point source process wastewater treatment in refineries and petrochemical facilities has many benefits. It reduces load and enables optimum performance on the CWWTP which, in turn, results in lower wastewater treatment and handling costs. The treatment method also enables sustainable water recycle and reuse within facilities, and is an environmentally green approach to conserving energy and low emissions and carbon footprint. Finally, point source process wastewater treatment improves workers' health, safety, and hygiene in plant environment.

MyCelx Technologies Corporation has developed and implemented numerous customized oil removal systems for point source treatment at O&G upstream, refining, and petrochemical facilities to enable water recycle and reuse. An exclusive distributorship and service agreement with **Siemens Water Technologies** is helping MyCelx to promote its oil removal technology in Saudi Arabia. The MyCelx technologies complement Siemens' water treatment technologies, acting as a polisher for API and CPI separators, hydrocyclones, flotation cells, and multi-media filters, or as pre-treatment for Siemens' broad array of membrane separation technologies. ■

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تُعمد تقنية تقليدية لمعالجة مياه الصرف الصحي في المصافي والمحطات البتروكيماوية، وهي عبارة عن تصريف مياه الصرف من جميع المصادر في مجرى صرف واحد قبيل معالجتها في محطة معالجة مركزية. على هذه المحطات أن تعتمد طرق جديدة في هذا المجال لملاقاة المعايير البيئية والصحية المعتمدة حالياً بالإضافة إلى معايير الأمان وتصريف المياه الملوثة والأهداف المطروحة في مجال إعادة تدوير المياه. تقدم شركة MyCelx حلاً لهذه المرافق في هذا المجال، هي عبارة عن أنظمة لإزالة الزيوت والمخلفات النفطية من المياه وإعادة تدويرها. تُطبق الشركة حالياً إحدى محطات معالجة المياه والمزودة بهذه التقنية في مرفق بتروكيماوي في منطقة الجبيل في المملكة العربية السعودية بنجاح كبير. يسمح النظام للمستخدم بإنتاج ١٦٥,٠٠٠ متر مكعب من المياه الخالية من الزيوت والهيدروكربونات سنوياً بالإمكان إعادة تدويرها وإستعمالها لاحقاً. وقعت MyCelx إتفاق توزيع وخدمة حصري مع شركة Siemens Water Technologies للمساعدة في الترويج لتقنيات إزالة الزيوت والمخلفات النفطية هذه في المملكة، وهي تأتي لتتكامل مع منتجات Siemens الرائدة في هذا المجال.

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