

How to remove BTEX and Phenols from wastewater

How Nyex[™] effectively and safely removes BTEX and phenol from specialty chemical wastewater - to below measurable levels.

Where are BTEX and phenols used?

BTEX and Phenols are some of the most essential chemicals used in modern manufactured products. Widely used by the specialty chemicals industry, they are constituent in everything from aspirin to analysis kits ... pharmaceuticals to paint.

Without them, it's true to say that modern life as we know it would probably cease to exist. They truly are the building blocks of modern chemistry, allowing talented chemists to create ever more effective products.

Naturally occurring in crude oil and commercially produced as a by-product of the cracking process in oil refining, BTEX and phenols are incredibly useful 'commodity' chemicals. However, in concentration, they're actually very dangerous and must be treated with the utmost caution.



Why do BTEX and Phenols need to be removed from wastewater?

BTEX

BTEX (benzene, toluene, ethylbenzene and xylene) are volatile organic compounds. They occur naturally in seawater, especially near deposits of crude oil. In recent years, higher concentrations in emissions from transport, along with the application and manufacture of coatings as well as all types of plastics manufacturing have led to the risks from these compounds to be brought into prominence.

Health issues relating to increased exposure to BTEX range from respiratory and gastro-intestinal issues right through to risks of brain damage and leukaemia. Even inhaling the fumes in any concentration for a few minutes can make people feel extremely unwell.

Phenols

Phenols are similar to alcohols but because they form stronger hydrogen bonds, they are more soluble in water and thus are more likely to be unwanted constituents of industrial wastewater.

In its simplest form, phenol is known as monohydroxybenzene (benzenol or more simply, carbolic acid) and was reportedly used as the first surgical antiseptic by British surgeon Joseph Lister in 1865.

However, medicine has come a long way from 18th Century 'kill or cure' treatments and although phenols are now widely used as a disinfectant in cleaners and mouthwash (in low concentrations of course) a small amount on the skin in concentrated form can cause severe burns and could eventually lead to death.

Even in low concentrations therefore, it's imperative that BTEX and Phenols are separated from wastewater as far as possible. Fortunately, the Arvia Nyex™ system is perfectly suited to remove these compounds down to below measurable levels.

How BTEX and phenols get into wastewater

There are two main ways by which these unwanted compounds can appear in industrial wastewater and both are an unavoidable by-product of many manufacturing processes.

- Water is used in the production process that also features BTEX and/or phenols.
- Any washdown or maintenance routines will add to concentrations of BTEX or phenols in water used.

With the increasing cost of water - and sometimes even its availability being under threat - it makes sense to purify plant wastewater as much as possible. Many companies are starting to consider the possibility of ZLD (zero liquid discharge). Nyex™ helps to make this possible.

Removing BTEX and phenols from wastewater

Most companies Arvia deals with are of a sufficient size to have trade effluent consents in place that will specify wastewater purity and so they are concerned about adhering to limits as well as minimising adverse CSR exposure.

Our Nyex™ treatment systems overcome the issues often experienced with traditional AOPs (advanced oxidation processes) and provide a robust and effective solution for the removal of organics. They work through a unique combination of adsorption and oxidation and can be placed at various points in many industrial water polishing processes.

As well as efficiency and high performance, the overriding advantage of Nyex™ systems is that the process leaves no residue, resulting in minimal maintenance, maximum up-time and no toxic residue requiring removal and incineration (itself a major cause of pollution.)

Our new-generation Nyex Rosalox™ systems can reduce BTEX and phenols to below the limit of detection in many specialty chemical processes – literally to parts per trillion, and in many processes has been shown to deliver COD polishing from >300 mg/L to below LOD.



Nyex™ as a complementary water treatment technology

Conventionally, in many industries, Nyex™ polishing systems are placed as a tertiary line of water treatment behind mechanical and biological systems.

However, when dealing with high concentrations of BTEX and/or phenols, the Nyex™ system often needs to be placed second in line after mechanical filtration, otherwise phenols and BTEX will destroy many of the active parts of a biological or RO system and render them ineffective. (In RO systems the expensive-to-replace membranes can be easily damaged by phenols.)

Nyex™ works as a complementary technology in most cases, removing specific recalcitrant and harmful organic compounds, whilst protecting existing processes like biological or RO.

Protecting other water treatment processes

Biological and reverse osmosis water cleansing are ideal for removing other unwanted compounds, but the damage that BTEX/phenols can do to a biological or RO system (and the relative ineffectiveness of removal of BTEX and phenols in these systems) mean that they need to work in tandem to deliver the best results.

So in many cases, we'll recommend a more modular approach with Nyex™ systems positioned in various key places in a plant to address these issues. All Arvia Nyex™ systems are scalable with a small footprint and no moving parts, requiring no chemical dosing. Additionally, they do not generate toxic sludge like many other water treatment systems.

GAC vs Nyex™

Granular Activated Carbon (GAC) is often used by the specialty chemical industry because it's also reasonably effective at reducing concentrations of BTEX and phenols. However, unlike Nyex™ systems, GAC has some major issues which can make it less environmentally friendly and less cost-effective.

1. The carbon bed needs replenishing from time to time; this means taking the equipment out of service leading to potential production suspension or changing over to a parallel system – which of course has its own implications in terms of CapEx. Changeovers need scheduling and are a potential problem if they don't happen regularly.
2. If too much phenol or BTEX is sent through a GAC it may become saturated before it is due to be refreshed, which leads to a breach of discharge certifications.
3. It's usual to insure against over-saturation (and any resultant environmental fines) but it adds to the OpEx considerably.
4. If a plant only has a very small GAC process and the medium is only changed twice a year then that's probably the most cost-effective solution. But a large GAC installation that has (say) its medium changed a few times a year will cost more in OpEx than an equivalent Nyex™ system that only needs topping up annually and has no waste.
5. GAC sounds eco friendly and fairly passive, but in truth it's neither. Trucking away the spent carbon is clearly not environmentally friendly. Also, to refresh the carbon takes a lot of energy, so essentially there is no net eco benefit.

Benefits of Nyex™

As a consequence of the way it works, combining absorption and oxidation, Arvia's Nyex™ system is particularly effective in treating BTEX and phenols at both low and high flow rates. In both lab and real-world tests, we've achieved excellent results down to parts per trillion – essentially below LOD.

The main benefits are:

- No waste: Arvia's latest Nyex Rosalox™ system combines adsorption and oxidation into one space-efficient system, resulting in targeted and complete destruction of contaminants – all without the production of secondary wastes.
- Dosing not required: Using Nyex™ avoids any handling or storage issues with chemicals, H&S training for maintenance teams, COSHH compliance and risk assessment paperwork as well as negative environmental impacts.
- Onsite treatment: Nyex™ negates the high costs and negative environmental impact of having sludge or media transported and disposed of regularly. Our Nyex™ media is simultaneously regenerated during the treatment process. All a Nyex™ reactor needs is a minimal top up annually.
- High up-time: There's no need to stop processes to clean or replace fouled membranes as you'd have if only using a RO process.

We believe that a Nyex™ water polishing system is the most reliable and cost-effective way to eliminate BTEX and phenols from many manufacturing processes' wastewater.

To speak to a chemical engineer who understands the science of your industry and will be able to offer a solution specific to your company's water treatment challenges. Call us on +44 1928 515310 or email us at info@arviatechnology.com today.



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