# Water Challenges for the Oil & Gas Industry

The water crisis of the 21st century is upon us and as populations increase, enormous pressure is placed on worldwide watersheds. Affordable clean water is becoming a pressing technological issue facing the world, and by the year 2025 it's estimated two out of every three people could be living in water-stressed regions while world demand is increasing by 140% or 97.5 million cubic meters of water per day.

Water demands for agriculture and industrial processes will continue to increase while under extreme aggravation from worldwide droughts. It is now estimated that industrial demand will exceed human consumption by 2020 resulting in shortages, tougher continuing Federal regulations and mandates regarding industrially produced water recycling. Water use and processing of produced water in the oil and gas industry is creating additional challenges globally.

With fracking innovation driving energy independence in the US, producers are facing a new dynamic in wellhead production and water resource management. They include: water sourcing; water use & efficiencies; produced water management; and waste water management.

In addition, prohibitions on disposal wells, due to seismically sensitive areas experiencing tremors and mild earthquakes, has led to increasing litigation and liability for producers in those areas as well as higher disposal costs.

Neptune FS Global has the technology solution to solve these problems now. Through our Fisk Neptune Processor, a fully mobilized solution for water remediation, water can be managed from fracking to produced water treatment and disposal. The system will:

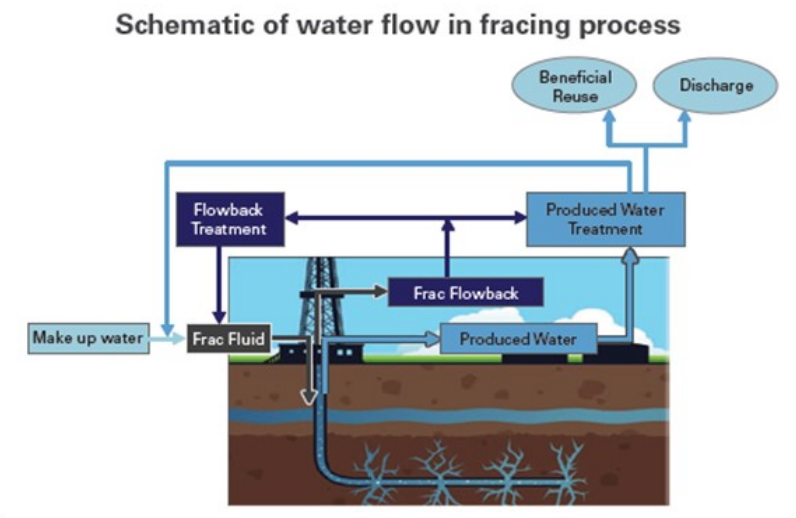
- **Provides clean brine or potable water (meeting US clean water standards) for down hole operations and fracking.**
- **Allows for in-field operation near the wellhead thereby reducing or eliminating costly trucking and logistics support for disposal.**
- **Eliminates the need for disposal wells or evaporation ponds when producing potable water through environmental discharge (where permitted) or venting to atmosphere as clean steam.**
- **Acts as a carbon sync by using flare gas or residual hydrocarbons to power the unit while processing produced water to clean brine or potable output for reuse by operations.**
- **Employs Zero Liquid Discharge (ZLD) technology while drying residual waste streams for disposal.**
- **Results in a lower cost of processing and disposal over the combination of current logistics, evaporation pond and/or disposal well solutions and other technologies.**
- **Addresses the problem of litigation due to disposal well seismic impact.**

*Neptune FS Global is creating a unique technology portfolio while providing services to key industries with high water demand. This approach drives our diversification but leverages a common strategic view of the market and allows us to offer services that benefit our clients, our shareholders, and society.*

## The Overview

# Solving the Produced Water Reclamation Problem

The hydraulic fracturing process can use more than 5 million gallons of water per well. Produced water from operations can result in 10 barrels of water for every barrel of extracted oil. As a variety of organic and inorganic compounds are used in fracturing fluids to optimize formation fracture and proppant transportation, it is of the utmost importance that the correct water quality is used during operations to ensure unwanted salts and compounds do not interfere with the performance of the fracturing fluid. Additionally, deep gas seams are often associated with hyper-saline deep aquifers, which generate hyper-saline formation (produced) water.




*Source: EPA*

## The Fisk Neptune Processor

Neptune FS Global has developed new flow through technologies designed to treat and recycle contaminated oil flowback water generated by the petroleum industry. Flowback water is mainly utilized in well drilling to improve harvest extraction efficiencies and it consists mainly of freshwater containing a chemical brine mixture of polymers used as viscosity agents. Approximately 1~3% of a given site's daily production rate can be lost due to oil emulsification within flow back and produced water. The technology further allows this lost oil to be recovered while simultaneously treating for recycling other contaminants without the addition of chemicals or other flocculants.

## Scale Drives Demand

Industry estimates suggest there are over 42 billion gallons of flow back and produced water generated annually within the United States alone, all containing various levels of contaminates. Of this amount, 6 billion barrels or 252 billion gallons, could be treated for recycling.

Oil and gas producers are all coming under significant political and regulatory scrutiny for traditional water waste and disposal practices. Deep concerns are surfacing over environmental damage as well as public health. The costs of water waste and disposal well operations both in dollars and in terms of public image are skyrocketing as oil and gas producers continue to increase production across the United States.

In locations where local water sources are insufficient or otherwise unavailable or where the cost to import water to the location becomes prohibitive, then water from previous oil or gas operations (flow-back water), is processed through pre-treatment for re-cycling. When unacceptable salinity levels rise from repeated injections, a more costly desalination treatment is required prior to re-injection.

## Economic Viability

The sheer market size in terms of gallons of fresh water used annually for hydraulic fracturing is very high and proves the immediate demand for new water treatment technologies. It's estimated over 140 billion gallons annually is required at an average cost of $0.21 per gallon with disposal costs running from $2.00~$11.50 per barrel. This represents an approximate $30 billion per year industry alone in the United States. In a recent report by Lux Research, they concluded the "produced water market will grow nine-fold by 2020 due to the boosting of new fracking technologies".

## Reducing Risk

Neptune FS Global understands the costs of water treatment and the current increasing litigation due to the impact of disposal wells on geologically sensitive areas that has resulted in tremors or earthquakes.

Evaporation ponds are coming under pressure from environmental groups due to the impact on migratory waterfowl and local fauna.

As disposal wells are shut down, logistics costs increase. When potential litigation is considered, solving the produced water problem at the wellhead or in the geography nearby becomes a key differentiator for the Fisk Neptune Processor technology solution.

# Fisk Neptune Processor Technology

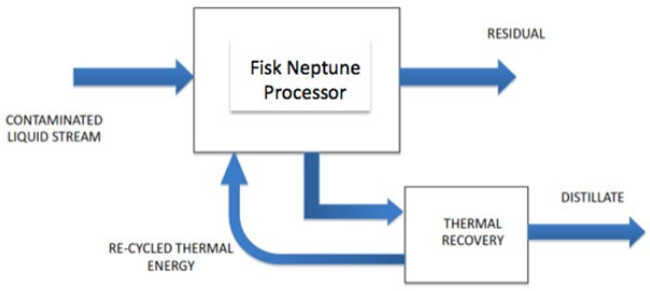
## The Science

Oily-wastewater is composed of suspended oily lipid droplets in water, interspersed with solid particles and with dissolved compounds, each having different molecular weights, chemistries and electrical charges. These electrical charges can be measured as the 'zeta potential and tend to keep oily lipid droplets, solid particles and dissolved compounds from interacting chemically. Electrical charges tend to form a semi-stable emulsion (similar to milk), which is difficult to separate. However, under suitable conditions of a controlled and carefully applied DC voltage and current, several unique electro-chemical effects result:

- Coalescing Super Coagulation - Fisk Neptune Processor neutralizes the charges surrounding the lipid droplets, allowing them to quickly coalesce and 'super-coagulate out of an emulsion. This applies to both heavy and aromatic- hydrocarbons, with specific results in coalescing and super-coagulating dependent on molecular compound weights and their concentration within the fluid stream.
- Chemical Oxidation- Fisk Neptune Processor creates free hydroxyl (OH-) radicals in solution which rapidly and aggressively combine with oily lipids, particulates and dissolved compounds, depending on their individual chemistries.
- In particular, Fisk Neptune Processor has the potential to breakdown complex organic molecules, including high molecular weight compounds that may be resistant to other forms of treatment, (such as pesticides, herbicides, dyes and wet-process chemicals).
- Fisk Neptune Processor works on many dissolved metals by forming stable metallic oxides which rapidly precipitate from solution as particles which allows a high level of removal and directly reduces chemical oxygen demand in some waste water cases.
- Biological Inactivation- Fisk Neptune Processor free hydroxyl (OH-) radicals rapidly and aggressively combine with and destroy bacteria, viruses, cysts, macrophages and other biological contaminants, similar in effect to using ozone, but at a level of magnitude better. Depending on water chemistry and its contact time, inactivation is achievable. This biological inactivation potential is being used by the US military as a pre-treatment with reverse-osmosis (RO) to prevent biological-warfare on potable water supplies.
- Fisk Neptune Processor has achieved nearly unobtainable wastewater treatment efficiencies through distillation and thermal dissociation. Prior to this innovation, distillation and thermal dissociation processes were cost prohibitive. A major technology resulted in this newfound efficiency. In order to evaluate the applicability of Fisk Neptune Processor to particular wastewater process streams thorough and detailed water chemistry should be conducted along with a volume sampling for bench testing to confirm theoretical prediction of treatment efficiency.

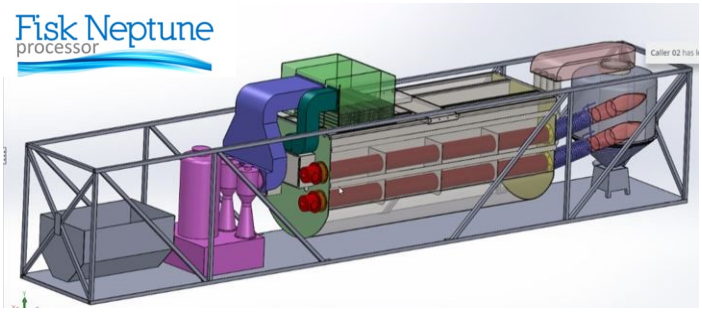
## Targeting Distillation Applications

Distillation has shown to be an effective process for wastewater contamination. Its shortcomings are metallic and salt plating of the heat exchangers and inability to produce a complete product of a full reduction of waste stream. Fisk Neptune Processor can be used upstream of standard filtration units to pre-oxidize and pre-sterilize raw water, removing BOD, COD, dissolved metals and biological contaminants. Pre-treated water can be subjected to Fisk Neptune Processor bypassing sand filtration, ultra-filtration, GAC and CDI/ RO, as required for raw water conditioning. The system meets all necessary potable water standards.




**FNP Process Flow**

**3D Illustration of the FNP**



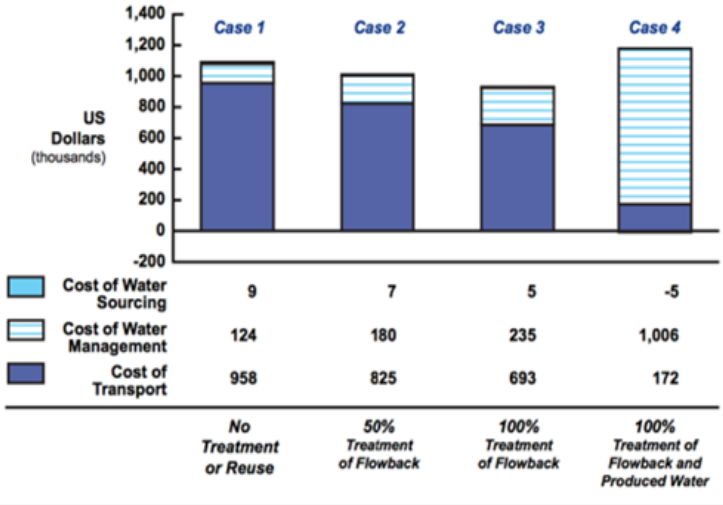
# The Opportunity

The demand for clean water will collide with the boom in International and U.S. oil production as the industry increases the use of induced hydraulic fracturing or hydrofracturing, commonly known as fracking, a technique used to release petroleum, natural gas, (including shale gas, tight gas and coal seam gas) or other substances for the extraction of petroleum from shale rock with the use of water and pressure. The natural gas industry adopted fracking technologies much earlier than the oil industry, resulting in natural gas prices now being at an all-time low.

The oil industry began adopting these new technologies approximately two years ago and this is expected to result in a boom likely to rival any prior oil booms experienced. Increased oil production will also further the water burden as demand grows during a time of recurring drought conditions exist around the world. Therefore clean and affordable water is quickly becoming a thing of the past as its value is expected to increase well beyond the cost we all encounter today.

There are over 1.1 million oil & gas wells in production in the US (100K new wells coming on line each year) with a treatment/ disposal market exceeding $30B. The average well uses 5 million gallons of water for fracking and produces a further 5~10 barrels of water for each barrel of oil extracted from the well. Costs to treat and dispose this water range from $2.00~$11.75 per barrel.

**Lifetime Cost of Water Management: Hypothetical Marcellus Shale Gas Well**




*Source: IHS*

Neptune FS Global, through the Fisk Neptune Processor, has the solution providing reduced operating costs, improved environmental impact and flexible deployment in the field for all of your water processing requirements.

## Mark A. Skoda, CEO

***"Neptune FS Global, through our patent-pending technology, is positioned to meet and exceed the EPA requirements for water processing in the global water remediation market today at costs that are below traditional methods of processing and disposal."***

## Contact Us

Give us a call for more information about our services offering.


**Mark A. Skoda**

**Chief Executive Officer**

**mark@neptunewrs.com**

**901.277.4968**

**www.neptunefsglobal.com**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