

## Headworks Bio Provides Enhanced Treatment for Sohar Industrial Port in Oman

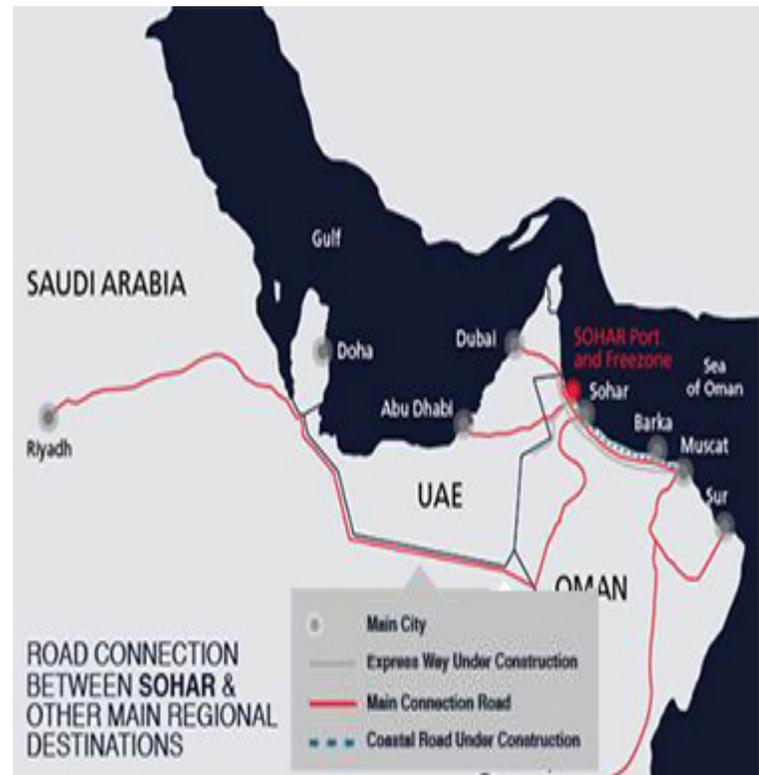
### Background

#### The Sultanate of Oman

Oman borders the Kingdom of Saudi Arabia to the west, the United Arab Emirates to the north, and the Republic of Yemen to the southwest. With an area of over 300,000 square kilometers, geographically, Oman is one of the most diverse countries of the Peninsula.

Oman's coastlines borders the Sea of Oman and the Arabian Sea. The strategically important Strait of Hormuz is the only stretch of water between the Gulf and the Indian Ocean and is, therefore, a vital route for the transportation of crude oil, gas, and cargo. Arabia to the west, the United Arab Emirates to the north, and the Republic of Yemen to the southwest. With an area of over 300,000 square kilometers, geographically, Oman is one of the most diverse countries of the Peninsula.

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Sohar Port – Operating from a strategic location on the Arabian Peninsula

## Sohar and Sohar Port

Sohar lies in the center of the Al Batinah North Governorate, in the North of Oman. This is a prime area for investment. With its geographical location, economic resources and high population density, the Al Batinah North Governorate has played an important part in Oman's history. It has always been the country's maritime and commercial outlet to the Gulf and the Indian Ocean and its mineral resources have provided the basis for several important heavy industries.

Sohar Industrial Port in Oman has been a key milestone in boosting the economy of Oman since its opening to commercial vessels in April 2004. With current investments exceeding \$26 billion USD, it is one of the world's fastest growing port and free zone developments and lies at the center of global trade routes between Europe and Asia.

Sohar is currently home to logistics, petrochemicals, metal and food clusters that feed downstream industries with iron and steel, plastics and rubber, ceramics and chemicals. Today it handles over one million tones of sea cargo each week and over 2,600 ships a year. The port is equipped with deep-water jetties capable of handling the world's largest vessels, the Valemax class of dry bulk carriers.

*"IFAS technology was the ideal solution to upgrade the existing treatment plant without additional civil structures or new reactors, we doubled the treatment capacity and improved the plant performance by utilizing Headworks MBBR/IFAS technology. Headworks' experience in petrochemical wastewater, plus its local presence [in the Region] made it an ideal choice as the technology provider for the effluent treatment plant" explains Khurram Shahid, Planning and Projects Manager at Majis.*

## Majis Industrial Services

In 2006, Majis Industrial Services (Majis) was established to provide water services to Oman's growing industrial port and other special economic areas in Sohar. Majis started its operations by providing seawater for cooling purposes to the tenants of Sohar Industrial Port Area (SIPA) and has since grown to become a one-stop water utilities solution provider.

The existing wastewater treatment facility built in 2009 operated by Majis was designed to treat 3,000 m<sup>3</sup>/day of domestic sewage. Over the years, due to an increase in industries, generating additional wastewater streams from various sources, the existing wastewater treatment facility at Sohar Industrial port required upgrading from 3,000 m<sup>3</sup>/day to 9,000 m<sup>3</sup>/day facility.

The major reason for the increase in flow was due to expansion of the existing oil refinery in Sohar operated by Oman Oil Refineries and Petroleum Industries Company (ORPIC). Other than fuel products, ORPIC also produces significant volumes of naphtha and propylene, which serve as feedstock for an adjoining aromatics and polypropylene plant. Between the refinery, aromatics plant, and polypropylene plant, downstream synergies exist in plastics and other sectors. This resulted in an increase in flow and load to be treated at the existing treatment plant. The challenge was to provide a retrofit solution which utilizes the existing activated sludge plant with minimal capital investment whilst improving pollutant removal efficiency of the treatment plant to allow reuse and to accommodate the increased hydraulic and biological load.



This required an advanced biological treatment process to treat the industrial wastewater generated from the production of complex hydrocarbons. In April 2015, Headworks Bio Inc., based in Houston, Texas, was awarded a contract to design a biological wastewater system for Majis to be implemented by the main contractor, UEM Group based in New Delhi, India.

## Process Overview

The existing treatment plant was a conventional activated sludge process. With a total capacity of 3,000 m<sup>3</sup>/d, comprised of two parallel streams, each with an pre-anoxic reactor followed by an aeration tank and downstream secondary clarifiers for solids removal. Tertiary treatment was carried out through conventional sand filtration.



Existing Aeration tank before retrofit



Retrofitted Aeration tank and post Anoxic denitrifying reactor with AC 920 biocarriers

The existing plant was designed for typical domestic wastewater loads with a COD:BOD of 2:1, with an effluent requirement of NH<sub>3</sub> < 5mg/l and Total nNrates < 11.3 mg/l. With the addition of flows from ORPIC refinery, this increased influent flow to 9,000 m<sup>3</sup>/d and COD:BOD to 5:1. Coupled with the challenge of treating higher flow and load, Majis required treated effluent to meet tighter discharge limits of NH<sub>3</sub> < 1mg/l and Total Nitrogen (TN) < 15mg/l, in order to recycle the water for cooling towers.

One of the main challenges due to space constraints was to design a solution that could be retrofitted within the same footprint by using the existing reactors.

The existing activated sludge process was converted to a IFAS process with a newly constructed post anoxic reactor within the existing aeration tank. Each post anoxic IFAS reactor was designed with 40% mobile biofilm carriers (ActiveCell 920). The IFAS process employs Headworks BIO's proprietary mobile biofilm carriers (ActiveCell920) to support a very high concentration of attached biomass; and has excellent mass transfer conditions. The system achieves much higher loading rates than other biological treatment systems and is not prone to sludge bulking problems, oxygen deficiency or mechanical problems that can occur with other systems.



## Process Overview Continued

The neutrally buoyant HDPE ActiveCell920 biofilm carriers within the anoxic reactor provide a stable base for the growth of a diverse community of microorganisms. Every biofilm carrier has a very high surface-to-volume ratio, allowing for a high concentration of biological growth to thrive within the internally protected areas.

To retain the ActiveCell biofilm carriers inside the anoxic reactor, stainless-steel screens are fitted to the tanks outlet. The screen material is a stainless steel wedge wire mesh with welded construction. The screens are designed to not require any maintenance for the life of the system.

A unique feature of the design uses Bio carriers in a post anoxic reactor as oppose to traditional method of mixed liquor suspended solids which allows for a smaller footprint and better control on TN removal. The unique design of Headworks Bio AC 920 media makes it suitable to use with mixers inside the post anoxic IFAS reactor to ensure proper mixing allows for an extremely compact solution.



*Post anoxic denitrifying reactor with AC 920 biocarriers*

## Results

Headworks Bio's process provides a perfect solution for treating high loaded wastewater which is normally difficult to treat with conventional biological process. By using Headworks Bio's proprietary media offering high surface area, it resulted in sufficient formation of biofilm to handle the occasional variations in incoming load. The Majis plant today treats approximately 9,000 m<sup>3</sup>/day with an influent COD of 560 mg/l, BOD 125 mg/l and TN < 70 mg/l, and achieves COD reduction of < 100 mg/l, NH<sub>3</sub> < 1mg/l and TN < 15mg/l at outlet respectively.



*Active Cell 920 media, with biofilm growth.*

Headworks Bio's MBBR/IFAS is an ideal process for refinery applications where biological treatment is required. This technology provides effective removal of high concentrations of BOD, COD and VOC. Our robust systems are extremely stable and not upset by high variations in loading.

Typically, wastewaters from the petrochemical industry that are to be treated in a biological system vary greatly from process to process, as well as by location. The concentration of organic matter (COD) within the wastewater for refineries ranges from a few hundred mg/L to around 1,000 mg/L COD for chemical plant effluent, and even higher for some special chemical process waters. The discharge limits for the treated waters also vary due to local regulations, customers and sensitivity of the receiving environments.

This wide diversity of wastewaters and effluent water quality requirements call for different treatment solutions. The biological wastewater treatment solutions offered by the team at Headworks Bio are designed to meet the specific needs of each of our customers.