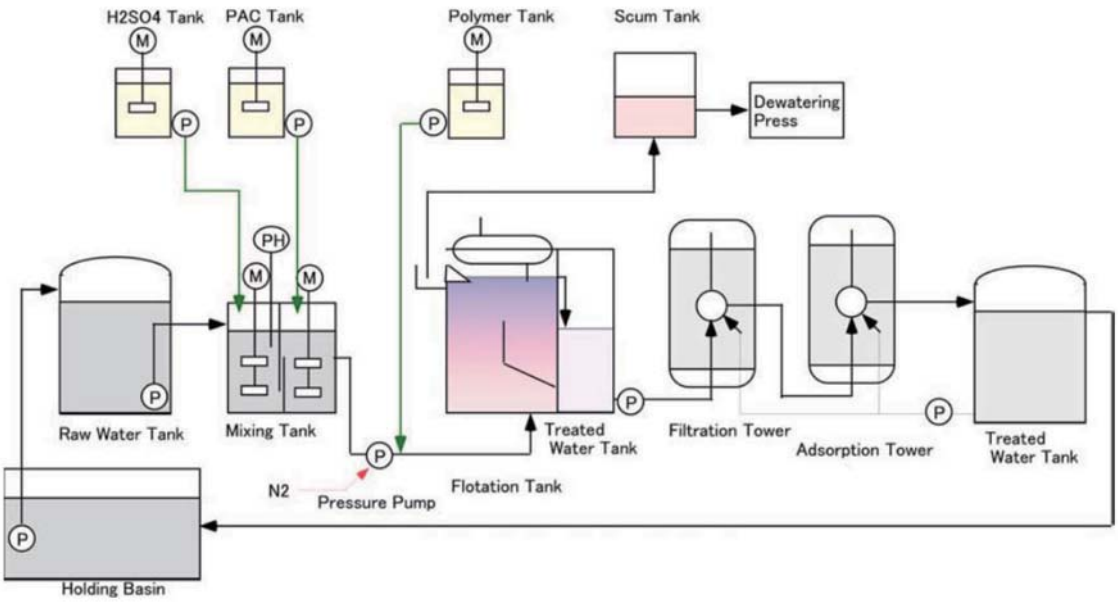
Joint Project on Treatment and Utilization of the Oilfield-produced Water in Oman Phase II

Oilfield-produced water (oily wastewater that is generated in association with the production of crude oil) accounts for the largest ratio of waste matter that is generated in the process of crude oil production. In the case of Petroleum Development Oman (PDO), a major crude oil production company in Oman, the amount of produced water that is pumped up with crude oil is roughly eight times the amount of crude oil produced, and is increasing yearly as crude oil is pumped up. Oil droplets contained in produced water are extremely small (30μm or smaller in diameter) for the most part, and cannot be completely separated using existing gravity oil separators. For this reason, the Omani government has prohibited the discharge of produced water into shallow aquifers (100-200m underground), calling instead for it to be discharged into deeper aquifers (approx. 1,000m underground). Due to this change, large pumps with greater motor power have become necessary, and the cost of discharging produced water has risen, creating large demand for treatment technologies that would treat produced water even further so that it could be used aboveground.

In some oilfields in southern Oman, produced water contains a relatively low concentration of salt of around 4,000 – 7,000 mg/L. Therefore, if the oil content in such produced water could be adequately removed, the treated water could be used as irrigation water. As a single oilfield alone produces some 250,000 m^3/day of produced water, corresponding to roughly the average amount of water supplied daily to the capital city of Muscat, produced water could be considered a latent water resource that is available in abundance. Thus, securing new water resources such as by recycling oilfield-produced water while also maintaining existing water resources is indispensable to sustainable development in Oman.

The objective of this study is to treat oilfield-produced water in Oman using low-cost wastewater treatment technology, and to perform a pilot test for the effective utilization of the treated water. The effective utilization of oilfield-produced water would resolve the waste issue accompanying oilfield development, and contribute significantly to the sustainable development the country seeks, by creating a new water resource.

In consideration of the above, JCCP launched the Joint Project on Treatment and Utilization of the Oilfield-produced Water in Oman Phase II as a FY2013 project, as outlined below.



Flow of the pilot plant used in the study

1) Implementation period: April 2013 – March 2014
   The project commenced in 2011, slated to end in FY2013.
2) Overseas counterpart: Sultan Qaboos University (SQU)
3) Participating company: Shimizu Corporation
4) Activities during FY2013:
   (1) Examination of effective removal methods for produced water using EOR technology
   (2) Treatment test of EOR-applied water using a pilot plant
   (3) Coagulation-flotation treatment using two-phase swirling flow microbubbles
   (4) Cultivation of algae using EOR-applied produced water and treated water

A pilot plant was installed on campus at SQU as described below to examine the treatment of oilfield-produced water and other related issues.

The following is an overview of results achieved during FY2013.

(1) A laboratory test was performed to compare the performances of polyaluminumchloride (PAC), which has been conventionally used as a coagulant, and aluminum sulfate (AS). As a result, it was confirmed that AS is effective for coagulation sedimentation of viscous produced water like the water in question in Oman.

(2) EOR-applied produced water was collected in June, August and December, and a continuous treatment test was performed using a pilot plant. Additionally, the coagulation sedimentation effect of AS was confirmed in the case where polymer is used as a thickener in the EOR process.

(3) After supplying raw water to the coagulation mixing tank and sufficiently mixing it with AS, it was supplied to the filtration tank at low pressure, and high-polymer coagulant was fed to the flotation tank so as minimize destruction of the floc. Through this process, it was confirmed that good oil content and SS content could be separated from produced water.

(4) It had already been confirmed that produced water with low salt concentration could be used as agricultural irrigation water. However, consideration needed to be given to possible health hazards if a thickener is to be used in the EOR. If algae could be cultivated, the possibilities of using thickened produced water would expand. Through this fiscal year's examination, it was found that the concentration of thickener in the EOR agent has no impact on the development of algae.

The activities implemented during FY2013 confirmed that oilfield-produced water that has been subjected to an EOR process could also be treated continuously even if a thickener has been applied, if an appropriate agent is used and the treatment method is improved. Additionally, the necessary information was acquired for scaling up the project, and a cost estimate was created.

The project ended in fiscal 2013, but it is expected to strengthen future relations with Oman and contribute to deepening ties between Japan and Middle East oil-producing countries.

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