

# Special Cooperation Study on Technical Support of Introduction of Formation Water Treatment for Refineries in Southern Region of Iraq

“Study on Technical Support of Introduction of Formation Water Treatment for Refineries in Southern Region of Iraq” was implemented as a special cooperation project for Iraq funded by the FY2013 METI subsidy, with the participation and cooperation of the Water Reuse Promotion Center and Swing Corporation.



*Formation water gushing forth*

## 1. Background

Iraq boasts the world’s fifth-largest oil reserve (150 billion barrels according to 2012 year-end BP statistics), and faces large expectations to produce increasing amounts of crude oil. As the oil industry requires large volumes of water, Iraq has conventionally depended on the Tigris and Euphrates Rivers to supply the industry’s water needs, but it is now hard-pressed to secure alternative water resources, given the recent decrease in river water volume accompanying the construction of dams upstream in neighboring countries and water quality deterioration in the southern region.

Fortunately for Iraq, large volumes of formation water have been confirmed in the country, and the Ministry of Oil-Iraq is considering using formation water as a new water resource to avert a crisis in water supply to oil fields. The formation water that the ministry has targeted has been gushing forth continuously for 30 years, and its abundance has been actively confirmed through geological surveys. However, since formation water contains sulfate and has a rather high concentration of salt, it cannot be used as is, and must be treated in some way.

Under this situation, Petroleum Research & Development Center (PRDC), an establishment of the

Ministry of Oil-Iraq, requested JCCP's cooperation in developing and introducing an effective water treatment technology in 2012, and JCCP spent a year implementing a cooperation study.

## 2. Objective

The study aims to propose a water treatment technology that is applicable to treating and recycling formation water in the southern region of Iraq to South Oil Company (SOC), a national oil company governed by the Ministry of Oil-Iraq, in response to a request from the ministry for implementation of a cooperation study toward this goal.

## 3. Content and Progress

The following activities were conducted in fiscal 2013: information was collected on the water quality of industrial water in the oil industry; the target quality of treated water was clarified based on that information; a survey was conducted on the actual state of formation water; the properties of formation water were confirmed based on an analysis of water quality; a table test was performed using formation water; and treatment processes were examined and presented to the Iraqi side based on the results of the water quality analysis and table test.

### ■ Water quality analysis

Water quality was analyzed twice, roughly one month apart. Five-liter samples for analysis were collected in Iraq, first in June, and next in July. The samples collected in June arrived in Japan in approximately two weeks, and those collected in July arrived one month later.

As a result of analyzing the water quality of the samples in Japan, they were found to be brackish with



*External appearance of a water sample package*

a TDS (total dissolved solid) concentration of several thousand milligrams per liter. They had a relatively high concentration of sulfate ions, and contained certain amounts of organic substances, as well.

### ■ Establishment of water quality target

In addition to examining the water quality of formation water, the water quality of industrial water used in Iraq's oil industry was also examined as reference for establishing a water quality target for treated water.

### ■ Examination of treatment processes

In order to achieve the target water quality, formation water needed to be subjected to desalination treatment. In consideration of the volume of water to be treated, as well as ease of operational management, proven track record in Iraq, and other such factors, desalination treatment using an RO (reverse osmosis) membrane unit was decided to be adopted.

However, when performing desalination using an RO membrane unit, the RO influent water must satisfy stringent water quality requirements to maintain stable operations, and proper pretreatment tends to be necessary whenever the RO method is adopted. Thus, to examine appropriate pretreatment methods, formation water was once again sent to Japan from Iraq to perform a table test.

In the table test, a treatment method that has been mainly approved to have a physicochemical effect was selected and adopted for pretreatment of the RO membrane unit.

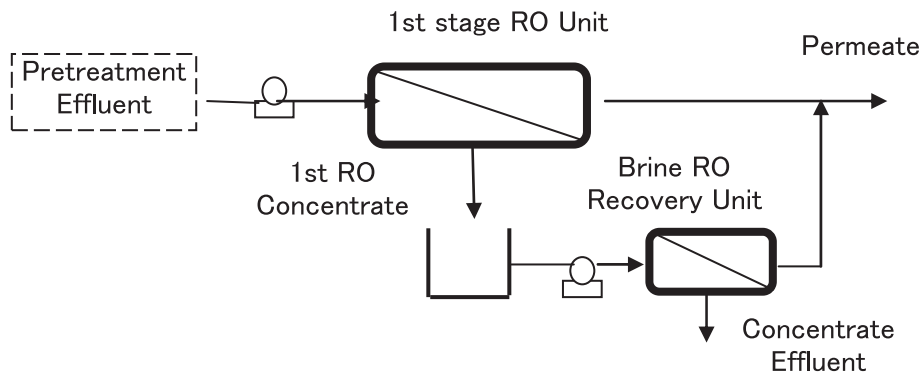
### ■ Selection of a treatment process

After analyzing water quality, selecting a pretreatment process based on a table test, and examining the effectiveness of desalination using an RO membrane unit, a treatment was selected as shown in the flow diagram below.

To maintain stable RO operation and increase water recovery rate in the RO treatment process, a desalination process that would increase water recovery rate was included as a process that could ensure both good water quality and stable operations, although stable operations would be affected to a slight degree.

### ■ Consultation with the Iraqi side

During this fiscal year's survey period, face-to-face technical meetings were held three times while exchanging information and views with the Iraqi side via email as necessary. In the technical meetings, the



*The selected treatment flow*

Japanese side reported on the method and results of the water quality analysis and the significance thereof, as well as the method and results of the table test and the underlying principle of the treatment flow derived from it. After active exchanges of questions and answers, the Iraqi side ultimately reached an understanding of the Japanese side's views and accepted the proposed treatment flow. The two sides then finalized the design requirements for a pilot plant, and will be taking it to the demonstration stage.

#### 4. Future Plans

The study will be developed and launched as a joint

project for Iraq this fiscal year, with plans to manufacture a 100m<sup>3</sup>/d pilot plant in Japan based on the proposed treatment process. Thereafter, Iraqi engineers will be invited to Japan to attend a technical training program to acquire knowledge of the concept of treatment, maintenance management methods, etc. Then, after transferring the pilot plant to Iraq, a demonstration operation will be conducted in Iraq, and the operational data will be shared between the two countries toward demonstrating the effectiveness of the treatment flow. The project is scheduled to be completed next fiscal year.

*<by Hironao Naganuma, Technical Cooperation Dept.>*



*After the consultation meeting*



*Consultation meeting*