तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान
Institute of Oil and Gas Production Technology
पनवेल, नवी मुंबई
Panvel, Navi Mumbai

Project Report

on

कलोल फील्ड के K-XII सैंड में पायलट एएसपी परियोजना के लिए भूतल सुविधाओं की अवधारणा

Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol Field

फ़रवरी – 2022

तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान
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कं.सं.: IO.21I.PT_AM.120U *दिनांक:* ***07/03/2022***

विषय: कलोल फील्ड के K-XII सैंड में पायलट एएसपी परियोजना के लिए भूतल सुविधाओं की अवधारणा

Subject: Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol Field

" कलोल फील्ड के K-XII सैंड में पायलट एएसपी परियोजना के लिए भूतल सुविधाओं की अवधारणा " रिपोर्ट की प्रति आपके अवलोकनार्थ एवं संदर्भ के लिए संलग्न की गई है।

Please find enclosed a copy of the report on "**Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol Field**" for your kind perusal.

नितिन.बी.जोशी
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Head of Department, SF & PE

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Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol Field

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Work Centre: Ahmedabad Asset

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Executive Summary

This pertains to the project titled "**Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol Field**" taken up by IOGPT at the behest of Ahmedabad Asset as an un-scheduled project under AWP 2021-22.

Kalol Field, discovered in 1961, lies within the Ahmedabad-Mehsana tectonic Block of Cambay Rift Basin. In order to enhance the oil recovery, IRS has outsourced the Chemical Enhanced Oil Recovery (CEOR) study from M/s Rhodia Operations, France for K-XII sand. Accordingly, Alkaline Surfactant Polymer (ASP) injection for K- XII sand with a normal five spot pattern having four injectors and one producer in smaller pilot area has been recommended. Further, the recommended total pilot ASP injection rate is 600 m^3/d.

Based on the study, Asset has planned to increase the recovery from K-XII sand of Kalol field by ASP injection. An MDT was formed by the Asset for preparation of Feasibility Report, for which IOGPT is entrusted with conceptualization of surface facilities for Chemical EOR pilot plant.

In the present study, scheme has been conceptualized for surface facilities for ASP pilot injection based on the inputs from the study by M/s Rhodia Operations. Facilities will be located near GGS-III installation and broadly consist of Treated Water Storage, Filters, Water Softening Plant, Alkali Preparation Tanks and dosing pumps, Polymer Processing Unit, Surfactants Storage Tanks & dosing, Co-solvent Storage Tanks & dosing, Inline Static Mixer, ASP Maturation Tanks, ASP Injection Pumps and Chemical Dosing System.

The details of the scheme are included in the report.

28/02/2022

Ravi Raman
Group General Manager
Head of the Institute

Contents

1.0 Background

Kalol field of Ahmedabad Asset was discovered in 1961. It is located ~20 km NNW of Ahmedabad city, covering an area of nearly 450 sq. km and lies within the Ahmedabad-Mehsana tectonic Block of Cambay Rift Basin. Kalol is a multi-layered field comprising of eleven pay zones. Pay zones II, III and IV are both oil and gas bearing while pay zones V, VI, VII, IX, X, XI and XII are mainly oil reservoirs. Kalol is currently contributing ~25 % of total oil production from Ahmedabad Asset.

Kalol Field is having ten GGSs, viz Kalol GGS-I, Kalol GGS-II, Kalol GGS-III, Kalol GGS-IV, Kalol GGS-V, Kalol GGS-VI, Kalol GGS-VII, Kalol GGS-VIII, Kalol GGS-IX & Kalol GGS-XI, two Gas Compression Plants (GCPs), viz. Kalol GCP-I & Kalol GCP-II, two ETPs, ETP-1 & ETP-2, two CWIPs, CWIP-1 & CWIP-2, one GCS and one CTF.

The current oil production from K-XII sand is around 61 m^3/d through 14 wells with average water cut of 65%. K-XII reservoir has recovered about 30% of STOIIP till date and has good petro-physical properties with permeability of 20-700 mD and porosity of 16-20%. The location map of Kalol field is shown in Figure 1.1.

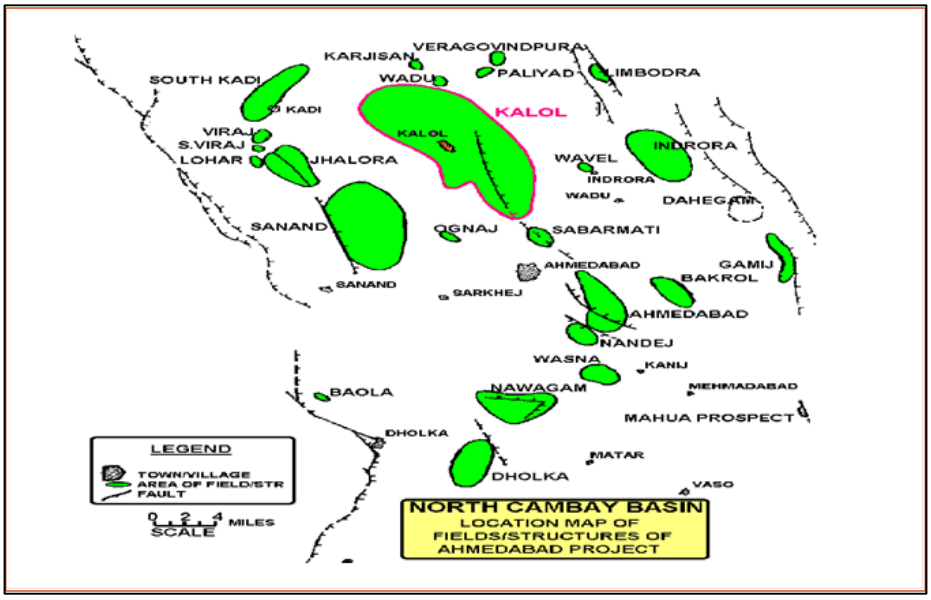

Figure 1.1: Location map of field/structure of Ahmedabad Asset

Asset has planned to increase the recovery from K-XII sands of Kalol field. Accordingly, Asset has formed an MDT on 22-03-2021 for preparation of feasibility report (FR) for CEOR (Chemical Enhanced Oil Recovery) pilot project in K-XII sand of Kalol field.

IRS has outsourced the pilot chemical EOR study from M/s Rhodia Operations, France for K-XII sand. Accordingly, Alkaline Surfactant Polymer (ASP) injection for K- XII sand with a normal five spot pattern having four injectors and one producer in smaller pilot area has been recommended. The Alkali Surfactant Polymer (ASP) injection rate in each injector well will be 150 m^3/d and pilot plant capacity will be of 600 m^3/d.

For preparation of FR, conceptualization of surface facilities for chemical EOR pilot plant was entrusted to IOGPT. Accordingly, a study titled "Conceptualization of Surface Facilities for Pilot ASP Project in K-XII sand of Kalol field" has been taken up as an unscheduled project in AWP 2021-22.

2.0 Scope of Work

- Scheme Conceptualization

3.0 Basis of study

As planned by Asset, Alkaline Surfactant Polymer (ASP) solution to be injected as pilot basis in K-XII sand of Kalol field for enhanced oil recovery. The pilot project design for K-XII sand was considered as normal 5 spot pattern with 4 injectors and 1 producer is as shown in Figure 2.1.

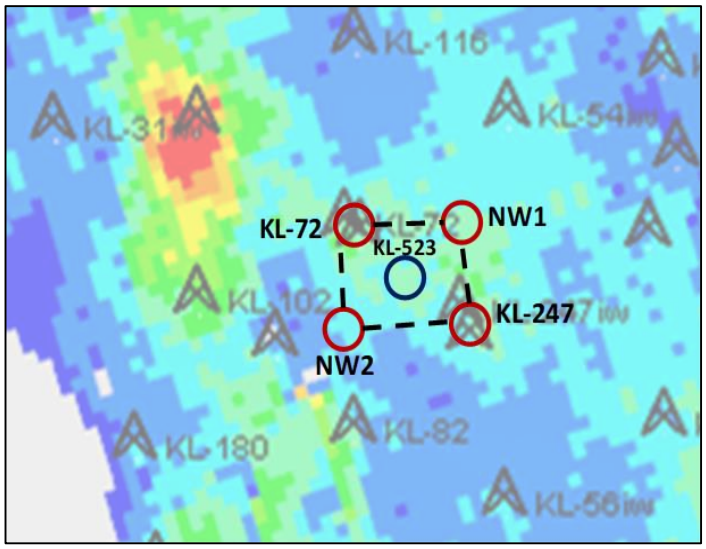

Figure 2.1: Injection pattern for Kalol K-XII

3.1 Pilot Chemical Enhanced Oil Recovery (CEOR) for K-XII sand of Kalol field

Asset has informed that a pilot project of a chemical Enhanced Oil Recovery (CEOR) technique i.e., Alkaline Surfactant Polymer (ASP) injection will be used in K-XII sand. It was further that in this process, chemicals viz: Alkali (Soda Ash – Sodium Carbonate), Surfactants with Co-solvent and Polymer in main slug will be prepared and injected in the wells for 1.09 years (400 days), followed by post flush (Polymer, Alkali, Adsorption Inhibitor) for 1.09 years (400 days) and then followed by chase water injection for 0.81 year (295 days).

3.2 The input data such as pilot injectors (well no's) details, producer well, ASP injection sequence and other relevant details of K-XII sand of Kalol field as provided by the Asset is given below in Table 2.1.

Table 2.1: Input data of K-XII sand of Kalol Field

Reservoir/Sand	**K-XII sand**
Injectors	4 wells (KL-72, KL-247 existing wells) and 2 new wells to be drilled by the Asset
Chemical injection rate	600 m^3/d total (150 m^3/d in each well)
ASP Chemical Injection dosage	
Main Slug	ASP injection Alkali : 1.0 wt% Surfactant-1: 3125 ppm, Surfactant-2: 1875 ppm, Co-solvent : 10,000 ppm Polymer : 1000 ppm
Post flush	Alkali : 1.0 wt% Polymer : 1000 ppm Al : 1000 ppm
SP/ASP Injection Pressure	100 kg/cm^2
Location of pilot CEOR surface facilities	At old ASP plant of Kalol GGS-III/CWIP-I(1)
Feed water to pilot plant	Treated effluent water
Source of feed water to SP/ASP plant (treated effluent water)	Existing treated effluent water tanks at ETP-I. Existing pipeline will be utilized.
Distance of injector wells from location of pilot chemical EOR surface facilities	KL-72 :1.2 km KL-247 :0.7 km New well-1 :1.2 km New well-2 :1.2 km
Producer well	New (to be drilled by the Asset)
Well fluid (W/F) withdrawal rate	150 m^3/day
Evacuation of W/F of pilot producer to nearest installation	GGS-III
Distance-producer well to installation	0.7 km
Treated effluent water analysis	Refer Table 2.2
Required soft water parameters	Refer Table 2.3
Injection fluid quality parameters (Desired value & tolerance limit)	Refer Table 2.4

3.3 Other parameters

3.3.1 No. of injection hours per day: 24 hours

3.3.2 Injection manifold : 4 wells (4+1 independent injection pumps interchangeable to all the injectors)

3.4 The information for injection water parameters (treated effluent), required soft water parameters and tolerance limit for ASP solution of Kalol K-XII received from the Asset are shown in Table 2.2, Table 2.3 and Table 2.4 respectively.

3.4.1 Injection water parameter (treated effluent) parameter provided by the Asset is shown in Table 2.2.

Table 2.2 Treated (effluent) Water Analysis report of K-XII

Sl. No	Parameters	Unit	Desirable limits/method of testing	Injection Water (Treated Effluent)
1	pH		ASTM	8.25 @ 33.9 °C
2	Chloride	mg/l	ASTM	4473
3	Sulphate	mg/l	ASTM	0
4	Bicarbonate	mg/l	ASTM	2257
5	Carbonate	mg/l	ASTM	60
6	Calcium	mg/l	ASTM	40
7	Magnesium	mg/l	ASTM	16.8
8	Sodium (calculated)	mg/l	ASTM	3717
9	Salinity(as NaCl)	mg/l	ASTM	7372
10	TDS	ppm	ASTM	10564
11	Turbidity	NTU	ASTM	11.20
12	Iron	mg/l	ASTM	0.290
*NT=Not traceable ,NR = Not Required				

Note: Treated effluent water parameters given in the above table are indicative. All parameters should be ascertained from the Asset based on actual field samples before designing water softening plant during detailed engineering.

3.4.2 The desired range/values of soft water parameters for ASP solution preparation provided by the Asset are shown in Table 2.3.

Table 2.3: Softened Water Parameters for K-XII

S.No.	Parameter	Desired Value	Tolerance limit
1	Ca^{2+} & Mg^{2+} (Total Hardness expressed as $CaCO_3$), ppm	< 50	< 50
2	Iron , ppm	< 0.1	0.5(max)
3	pH	6.5-8.5	6.5-8.5
4	SRB, Counts/ml	Nil	Nil
5	Dissolved oxygen, ppm	0.02	< 0.08
6	TSS, (mg/l)	< 2.5	< 2.5
7	Oil & Grease, ppm	< 10	< 10
8	Salinity(as NaCl), ppm	7300	6000-9000
9	TDS, ppm	10500	9000-12000
10	Turbidity (NTU)	<5	<10
Treated (effluent) water is considered as source of water			

3.4.3 Injection fluid quality parameters i.e., the desired value and tolerance limits for monitoring ASP injection as provided by Asset are shown in Table 2.4

Table 2.4: Injection fluid quality parameters for monitoring ASP injection for K-XII

S No	Parameters	Desired value	Tolerance limit
	ASP SLUG		
1	Alkali (Soda ash) wt%	1.0	0.95-1.05
2	Surfactant-1 (AGES), ppm	3125	>3000
3	Surfactant-2 (ABS), ppm	1875	>1750
4	Co-Solvent, ppm	10000	9000-11000
5	Polymer, ppm	1000	900 - 1100
6	Viscosity (at Reservoir Temp 95°C, $10s^{-1}$), cP	2.2	2.1 (min)
7	Turbidity, NTU	0-10	< 10
8	Filtration ratio@1.2µ	1.2	<1.2
9	Dissolved Oxygen, ppm	< 0.02	0.08 (max)
10	Iron, ppm	< 0.1	0.5 (max)
	Post Flush		
1	Alkali, wt%	1.0	0.95-1.05
2	Polymer concentration, ppm	1000	900 - 1100
3	Adsorption Inhibitor, ppm	1000	900-1100
4	Viscosity (at Reservoir Temp 95°C, $10s^{-1}$), cP	2.4	2.3(min)
5	Turbidity, NTU	0-10	<10
6	Salinity(as NaCl), ppm	7372	6000-9000
7	Filtration ratio@1.2µ	1.2	<1.2
8	Dissolved oxygen, ppm	< 0.02	0.08 (max)
9	Iron, ppm	< 0.1	0.5 (max)
	Chase Water (Softening Not required)		
1	Iron , ppm	< 0.5	< 0.5
2	pH	6.5-8.5	6.5-8.5
3	SRB, Counts/ml	Nil	Nil
4	TSS, (mg/l)	< 2.5	< 2.5
5	Oil & Grease, ppm	< 10	< 10

*Measurement of viscosity of the final solution (ASP slug as well as post flush) should be the preferred mode for monitoring purposes than polymer concentration measurement. In case of equipment limitation to measure low viscosity, measurement of polymer concentration through Canon Fenske technique can be used. However, in that case detail calibration chart with the permissible variation of alkali, raw water TDS and polymer must be prepared first.

4.0 Scheme Conceptualization of Surface Facilities for ASP Pilot Project in K-XII sand

A pilot scheme for ASP injection has been conceptualized as described below. The treated effluent water coming from the existing ETP-I is pre-treated to remove suspended solids, turbidity etc. Afterwards the pre-treated water is softened in a water softening plant. Finally, ASP chemicals are diluted in the soft water and then injected into the injector wells. The schematic diagram of surface facilities for ASP pilot plant is shown in Figure 3.1.

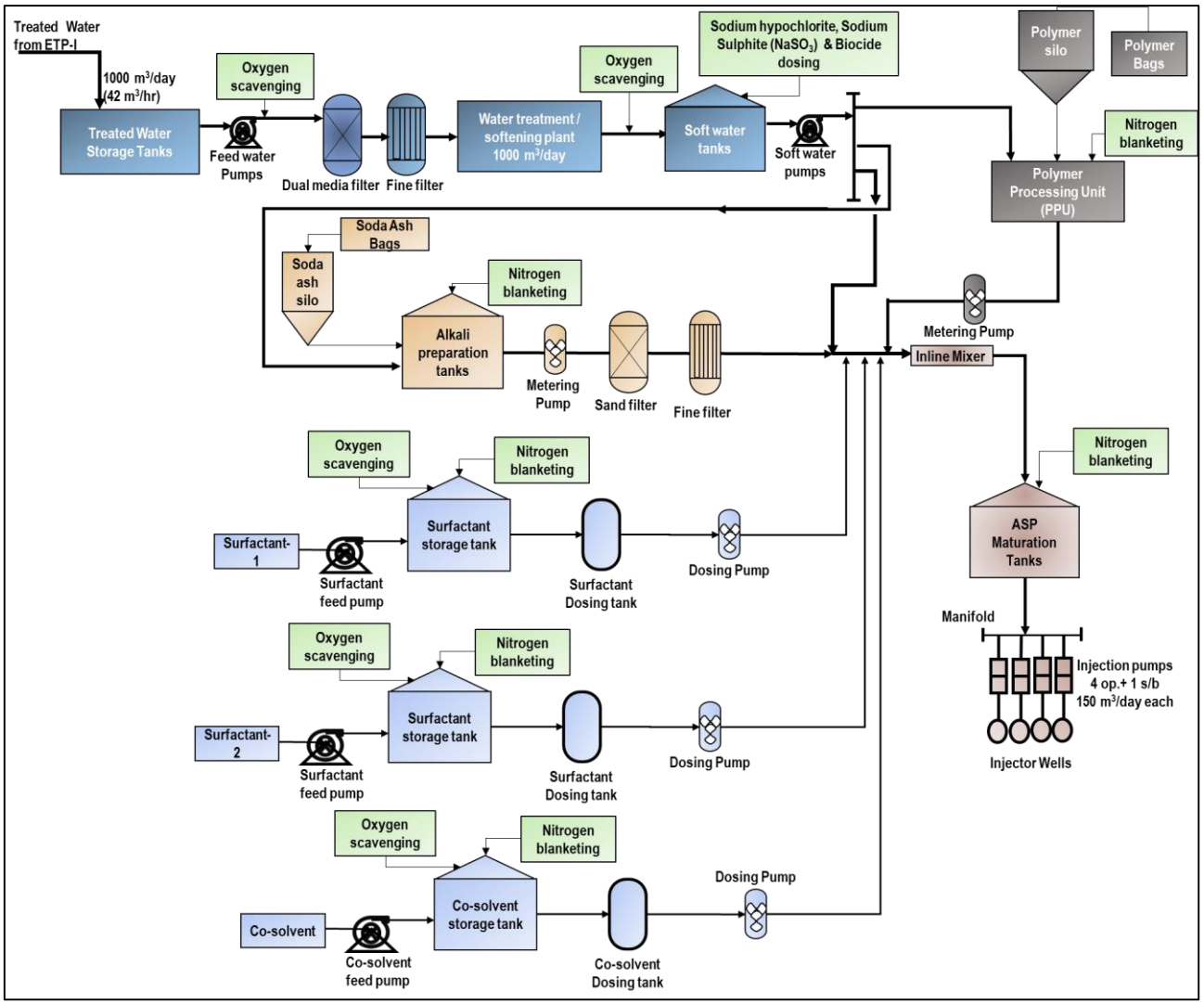

Figure 3.1: Schematic of surface facilities for ASP pilot plant

4.1 Treated (effluent) water treatment / softening plant

The water treatment plant shall be designed to produce soft water to meet ASP injection rate of 600 m^3/day (25 m^3/hr). Considering 40% reject water, a water treatment plant of capacity 1000 m^3/day (~42 m^3/hr) has been considered. As a preliminary estimate, 40% reject water is considered, however, based on vendor inputs during detailed engineering, the capacity can be determined.

The treated (effluent) water from the existing tanks of ETP-I will be transferred to feed water storage tanks of the proposed ASP pilot plant through an existing pipeline.

Water from feed water tanks shall be pumped to coarse filters (1 in operation + 1 standby) to remove particles ~~up to~~ above 20 µ size. The filtered water shall be further filtered through Ultra-Fine / Fine filter (1 in operation + 1 standby) installed in series in order to bring down the turbidity of water (as per requirement) as well as to remove all other particles greater than 5 µ size. The filters are required to be back washed when the pressure drop exceeds the certain limit or at regular intervals with treated water, using backwash pumps & air scouring blowers. Water is treated to remove suspended solids, turbidity etc. to meet the required input parameters of soft water plant. The treated water will be further treated in softening plant to meet the required soft water parameters (Refer Table 2.3).

Permanent softening of feed water, i.e., either resin based technology or membrane based technology will be required. Softened water from water softening plant will be pumped to soft water tanks. Reject water from water softening plant will be pumped to the existing effluent tanks.

Soft water will be required for preparation of Alkali & Polymer solution separately and for inline mixing of alkali, polymer & surfactant before routing it to ASP maturation tank to maintain required concentration. Soft water will also be used for preparation of utility chemicals like oxygen scavengers, NaOCl solution and biocides etc.

Soft water from the soft water tank is routed to the chemical dosing tanks for preparation of Biocide, Sodium Sulphite ($NaSO_3$) and Sodium Hypochlorite (NaOCl) solutions. A part of soft water is taken for Alkali solution preparation and for Polymer solution preparation in the Polymer Preparation Unit (PPU). Major part of soft water from the tank will be routed to inline mixer to maintain the required injection quality of ASP.

4.2 Alkali preparation, storage and dosing system

The alkali, i.e., sodium carbonate (soda ash) solution of 1.0 % (wt) will be prepared in 2 number of soda ash solution tanks. Soda ash bag of 750 kgs will be lifted and carried by means of crane and dropped in to the silo provided overhead of each soda ash tank. Then it will be added slowly in tanks filled with water simultaneously with continuous agitation. Soda ash solution will be pumped, initially passed through the sand filter followed by cartridge type fine filters, where particles of size greater than 20 micron and 5 micron respectively will be removed. The filtered soda ash solution is then routed to ASP tanks after mixing with the surfactant, polymer solution and soft water.

4.3 Surfactant storage and dosing system

Two different surfactants (ABS and AGES) are envisaged. Each surfactant brought by tankers will be pumped with unloading pumps in to the surfactant storage tank. The pumps will be used for unloading as well as to transfer surfactant from the surfactant storage tank to surfactant dosing tank. Suitable pump will be selected and decided during detailed engineering, as the pump will be used for both unloading purpose as well as transferring surfactant from storage tank to dosing tank. Asset informed that surfactants may be sourced internationally and hence desired to have storage capacity of 200 m^3 for AGES surfactant and 50 m^3 for ABS surfactant. Also, the surfactant ABS is acidic in nature and hence the storage tank should have acid resistant liner/coating inside the tank.

Surfactant from dosing tank will be transferred through metering pumps. Surfactant will be mixed with the soda ash solution & polymer solution thoroughly by passing through a static mixer and then will be taken to the ASP maturation tanks.

4.4 Co-solvent storage and dosing system

Co-solvent brought by tankers will be pumped with co-solvent unloading pumps in to the Co-solvent storage tank. The pumps will be used for unloading, transfer of Co-solvent from storage tank to Co-solvent dosing tank. As the pump will be used for both unloading purpose as well as transferring surfactant from storage tank to dosing tank, suitable pump will be selected and decided during detailed engineering. Asset desired for co-solvent storage capacity of 400 m^3 considering active concentration etc.

Co-solvent from dosing tank will be transferred through metering pumps. Co-solvent will be mixed in the respective ratios of surfactant, soda ash solution & polymer solution thoroughly by passing through a static mixer and then will be taken to the ASP maturation tanks.

4.5 Polymer preparation, storage and dosing system

Polymer solution will be prepared in Polymer Processing Unit (PPU). Soft water will be supplied to PPU for preparation of concentrated polymer solution. In PPU, dry polymer powder will be filled into the hopper of PPU, mixed with filtered water in the mixer for preparation of concentrated polymer mother solution. The prepared Polymer Mother Solution will be transferred to the static mixer through polymer metering pumps. Inline static mixer will be used for proper mixing of Soda ash solution, Surfactants and Polymer mother solution with softened water.

4.6 Alkali Surfactant Polymer (ASP) storage and injection pumps

Three number of ASP maturation tanks are envisaged in this design; one for ASP solution preparation, one ASP tank will be under injection and 3rd one under constant agitation. All the tanks will be equipped with slow

speed agitator to avoid polymer degradation and shearing. This agitator prevents any stratification and help in ageing, maturing and making homogenous ASP solution. ASP (Alkali+ Surfactant+ Polymer) solution will require to be mixed continuously under slow agitated conditions before injection.

All these tanks shall have N_2 blanketing system so that the solution prepared does not come in contact with the atmospheric oxygen. Positive pressure is required to be maintained inside the tank by maintaining 40 mm of water column over the gas outlet in the water seal drum. All the three tanks will be interconnected with nitrogen line so that while one tank is under filling, the excess N_2 gas will go to the tank which is under injection.

The prepared ASP solution will be taken into suction header of the pumps. For ASP injection, individual pumps for each well have been considered to maintain uniformity of injection rate and required ASP quality. Injection will be done in 4 injector wells hence, 5 (4 operating +1 stand-by) number of injection pumps are envisaged each having capacity of 6.3 m^3/hr with surface injection pressure of 105 kg/cm^2. The injection pumps shall be interchangeable to all the injectors. The pumps shall be low speed, low shear type with pulsation control device. The connecting lines i.e., suction line and discharge line shall have low shear with minimum curvatures. The injection line sizes will be determined during detailed engineering considering allowable velocities to minimize the shear. The process guarantee requirement for these pumps shall require that the viscosity degradation across the pumps shall be limited to less than 2%. These pumps will be metering pumps mounted with VFD to adjust the flow as per requirement. Injection flow rate of each well is monitored by ultra-sonic flow meter. The injection line will be provided with pressure gauges to monitor individual injection pressure.

Sampling of ASP solution shall be carried out frequently to check the concentration of different chemicals viz., Alkali, Surfactant and Polymer. Also, sampling is carried out to check dissolved oxygen content and other parameters as required by Quality control system.

4.7 Adsorption inhibitor injection (in post flush stage)

During post flush stage, an adsorption inhibitor along with alkali and polymer will be injected in wells. As the main surfactant will not be injected in the post flush stage, Asset informed the surfactant storage tank and injection set up can be used to handle the adsorption inhibitor.

4.8 Utilities

Utilities such as instrument air, nitrogen system, service water etc. and chemical dosing systems, drainage system etc. as described below are required in the ASP pilot plant. The capacity and specifications mentioned below are indicative and will be finalized during detailed engineering.

4.8.1 Air compressor package and Nitrogen generation plant

Air compression system is required to feed the plant air, compressed/instrument air and nitrogen system.

Nitrogen shall be used for blanketing of tanks and any other vessel used for polymer dissolution. Due to continuous requirement of Nitrogen at various units, either Nitrogen Generation Plant or N2 cylinder banks will be required. Water seal drums shall be included near each tank under nitrogen blanketing with water seal.

4.8.2 Service water

A new service water storage tank and transfer pump system is considered. Service water is required for eyewash, safety shower and other service water requirements.

4.8.3 Power

Power requirement will be around 150 kW. This shall be met from GEB supply.

4.8.4 Drainage System

Overflow/ chemical spillage/ wash water from filters, floor washings etc. drain out system is to be provided.

4.9 List of equipment for ASP Pilot Project in K-XII sand of Kalol Field

The indicative list of equipment is shown in Table 4.1 below.

Table 4.1: Indicative list of Equipment for ASP Pilot Project in K-XII sand of Kalol field

A	**Storage tanks**			
S N	Item	Qty.	Specifications	
			Capacity, m^3	Pressure, kg/cm^2g
1	Treated water storage tanks	2	500 m^3 each	Atm
2	Soft water storage tanks(1)	2	125 m^3 each	Atm
3	ASP maturation tanks with agitators(2)	1	300 m^3 each	0.03
4	Soda Ash preparation tank with agitator	2	50 m^3	0.03
5	Surfactant storage tank(3)	1	50 m^3	0.03
6	Surfactant storage tank(3)	1	200 m^3	0.03
7	Surfactant dosing tanks	2	2 m^3	0.03
8	Co-solvent storage tank	1	400 m^3	0.03
9	Co-solvent dosing tank	1	2.5 m^3	0.03
10	Biocide dosing tank with agitator(4)	1	2 m^3	Atm
11	Sodium hypochlorite dosing tank with agitator(4)	1	2 m^3	Atm
12	O_2 scavenger dosing tank (4)	1	2 m^3	Atm
13	Service water tank	1	5 m^3	Atm
B	**Pumps**			
S N	Item	Qty.	Capacity, m^3/hr	Pressure, kg/cm^2g
1	Treated water transfer pumps (at ETP-I to cater pilot ASP)	1+1	42	10

2	Feed water pumps		1+1	42	5
3	Soft water pumps		1+1	25	5
4	ASP injection pumps (5)		4+1	6.3	105
5	Biocide Dosing Pump		1+1	0.2	5
6	Sod. Hypochlorite dosing pump		1+1	0.2	5
7	O_2 scavenger dosing pump		1+1	0.2	5
8	Soda ash metering pump		1+1	5	5
9	Surfactant metering pump		1+1	0.10	5
10	Surfactant metering pump		1+1	0.26	5
11	Surfactant unloading pump		2+2	10	5
12	Co-solvent metering pump		1+1	1.0	5
13	Co-solvent unloading pump		1+1	10	5
14	Polymer metering pump		1+1	2.5	5
15	Service water pump		1+1	5	5
16	Reject water dispatch pump (centrifugal type) (As suggested by the Asset, reject water will be pumped to the effluent tanks)		1+1	18	5
17	Air Scouring Blowers		1+1	To be finalized during detailed engineering	
C. Mixer					
1	Inline Static mixer	--	1	--	--
D. Flow meters					
1	Ultrasonic Flow meters	--	4	6.3 m^3/hr	--
E. Filters					
S N	Item	Type	Qty	Capacity m^3/hr	Pressure drop
1	Coarse Filter 20 Micron	--	1+1	42	1.5 (Max)
2	Fine Filter 5 Micron	--	1+1	42	1.5 (Max)
3	Sand Filter 50 Micron for Soda ash	--	1+1	5	1.5 (Max)
4	Fine Filter 5 Micron for Soda ash	--	1+1	5	1.5 (Max)
F. Miscellaneous					
1	Water treatment / softening plant		1	42 m^3/hr	--
2	Air compressor package with dryer		1+1	Package item to be decided during detail engineering	
3	Nitrogen generation package		1	Package item to be decided during detail engineering	
4	Polymer Processing Unit (6) (It shall consist of Polymer slicing unit or Polymer dispersion unit (consists of mixing vessel with agitator, eductor in order to reduce the polymer maturation time)		1	2.5 m^3/hr	--
5	Crane		1	5 ton	--
6	Weighing Machine for solid weighing		1	0-50 Kg	--
7	Tripod with chain Pulley Block		1	--	--
G. Pipelines					
1	Injection Header		--	4”	Operating Pressure: 105 kg/cm^2g

				T: 25-45 ^{0}C
2	Injection pipelines	--	3" x 4.3 km	Operating Pressure: 105 kg/cm^{2}g T: 25-45 ^{0}C
3	Well fluid pipeline	--	4" x 0.7 km	--

Note:
1. 8 hours storage with 80 % filling is envisaged for estimating capacity of soft water tanks.
2. As informed by the Asset, existing 2 no. x 225 m^3 ASP tanks will be utilized. As already discussed in section 3.6, three number of ASP maturation tanks are envisaged. Eight hours storage with 80 % filling is envisaged for estimating capacity of each ASP tank.
3. As informed by the Asset, existing 1 no. x 100 m^3 surfactant tank will be utilized. Based on active concentration etc., Surfactant/Co-solvent storage tanks capacity shall be evaluated/determined during detailed engineering.
4. Suitable chemicals as disinfectants and oxygen scavenger shall be identified in consultation with Asset for injection and its dosage (capacity, dosing rates and metering pumps) during detailed engineering.
5. ASP injection pumps (VFD based) are interchangeable to all the injectors.
6. PPU is vendor specific package unit
7. Quantities and tank, pump capacities etc. are indicative and are to be firmed up in consultation with Asset during detailed engineering.
8. The injection line sizes to be determined during detail engineering considering allowable velocities to minimize the shear.
9. Power Requirement: Envisaged power required is 150 kW.

5.0 Conclusion

A scheme has been conceptualized for surface facilities for ASP pilot injection based on the inputs from the study by M/s Rhodia Operations. Facilities will be located near GGS-III installation and broadly consist of Treated Water Storage, Filters, Water Softening Plant, Alkali Preparation Tanks and dosing pumps, Polymer Processing Unit, Surfactants Storage Tanks & dosing, Co-solvent Storage Tanks & dosing, Inline Static Mixer, ASP Maturation Tanks, ASP Injection Pumps and Chemical Dosing System.

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