

**IRUP**

**STANDARD CONSTRUCTION SPECIFICATION  
FOR  
CHEMICAL CLEANING**

**DOC. NO. : H – 322**

**PROJECT NAME :  
RESIDUE UPGRADATION AND MS/HSD QUALITY IMPROVEMENT  
PROJECT**

**UNIT NAME :GT-HRSG**

**JOB NO. : 6235**

**CLIENT:**


**INDIAN OIL CORPORATION LIMITED  
GUJARAT REFINERY, VADODARA, INDIA**

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REV.	DATE	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY

**CONSTRUCTION AND PLANNING DEPT.**




**TOYO ENGINEERING INDIA LIMITED  
MUMBAI, INDIA**

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Annexure 1 : Procedure for Testing Inhibitor Efficiency.

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## 1.0 GENERAL

### 1.1 Scope

1.1 This Specification is prepared for chemical cleaning and post-cleaning passivation treatment of carbon steel suction piping of compressors prior to pre-commissioning. This specification covers the chemical cleaning of fabricated and erected carbon steel piping at plant site prior to pre-commissioning by chemical circulation method. The technical procedure is prepared only for carbon steel surfaces. Materials other than carbon steel shall not come in contact with pickling solutions. This procedure is for GT-HRSG plant constructed forming part of the Residue up gradation and MS/HSD Quality Improvement Project for IOCL's Gujarat Refinery in Vadodara. Indian Oil Corporation Limited (IOCL), has appointed Toyo Engineering India Ltd as "Project Management Consultant " (PMC).

### 1.2 Conflicts


Any conflict between the requirements of this specification and the provisions of any applicable codes, standards and customer's requirements shall be referred to Project Management Consultant (here in after referred as PMC) for resolution prior to the execution of work.

### 1.3. Application Codes and Standards / Specifications

The applicable codes and standards referred in this specification shall be as follows.

- 1) ANSI B. 31.3
- 2) H – 301 E
- 3) H - 103

1.4. All valves, Gaskets, control valves including butterfly valve, filters, venturies, instruments etc, shall be removed before Chemical cleaning.

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## 2. PURPOSE

**2.1.** The object of chemical cleaning of carbon steel suction piping is to remove the loose rust, dislodging the burs welding slag and mill scales adhering to the internal surface of the pipeline so that maintenance of compressors is reduced due to frequent choking of strainers. This procedure specifies the method of cleaning and passivation of internal surface of carbon steel piping based on use of inhibited hydrochloric acid followed by passivation with sodium hexametaphosphate, prior to taking in service for the first time after installation / fabrication.


**2.2** This cleaning will enable removal of: -

- a) Paint or varnish if used for protective purposes.
- b) Grease or Oil
- c) Mill Scales
- d) Loose rust
- e) Welding slag

**2.3** Any deviation from this specification shall be brought to the notice of PMC prior to application. The final result of this cleaning is that the metal surfaces are completely clean, dry and passivated without signs of corrosion.

## 3.0 PREPARATION OF TEMPORARY CIRCUITS

The cleaning may be carried out by circulating the specified solutions in the specified sequence and conditions. Temporary piping and a pump of appropriate capacity suitable for chemical cleaning may be used for this purpose as part of the circuit. All necessary temporary piping, fittings, flanges, pumps, tanks, heater coil, gaskets, thermometers, hydrometers, valves, test coupons, spares lab facilities with all accessories required for conducting test during cleaning operation, chemicals and safety accessories for operation personnel etc. shall be made available at site prior to chemical cleaning.

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#### **4.0 SEQUENCE OF OPERATION**


The sequence of operations shall as follows: -

- 4.1** Flushing with water to remove dirt, dust, loose rust and any foreign material
- 4.2** Degreasing
- 4.3** Inhibited acid circulation
- 4.4** Neutralisation with soda ash/ caustic soda
- 4.5** Rinsing
- 4.6** Passivation
- 4.7** Drying

#### **5.0 CHEMICALS**

The following chemicals are recommended for use in chemical cleaning operation: -

- 5.1** Caustic Soda-Rayon grade or technical grade conforming to IS:252 (latest edition)
- 5.2** Hydrochloride acid-commercial/ technical grade confirming to IS:265 (latest edition)
- 5.3** Corrosion inhibitor Rodine-213 specially manufactured by M/s. Agromore Ltd. or equivalent.
- 5.4** Glassy sodium meta-phosphate (sodium hexametaphosphate) confirming to IS: 574 (latest edition).
- 5.5** Soda ash, technical grade, confirming to IS: 251
- 5.6** Potable water should be used for preparation of chemicals solution & flushing/ rinsing operation etc.
- 5.7** All chemicals used for chemical cleaning shall be as per specification & shall be tested prior to cleaning.

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## 6.0 INSPECTION OF INHIBITOR BEFORE CLEANING.

A solution of inhibitor shall be prepared in hydrochloric acid as specified by the manufacturer & shall be tested for (a) the inhibitor efficiency & (b) the effectiveness of the solution in removing mill scale. The tests shall be conducted as given in Annexure I.

## 7.1 CLEANING PROCEDURE

The chemical cleaning shall be carried out as follows: -

- 7.1 The circuit (loop) shall be checked with circulation of water to test its tightness. Any leakage if observed to be attended & tightened.
- 7.2 The circuit (loop) shall be flushed with water to remove all extraneous matter, dirt & dust etc.
- 7.3 Filling and circulation of sodium hydrochloride solution for 2 hrs.(min)
  - 7.3.1 Temperature of sodium hydroxide solution during circulation should be 65 - 79<sup>0</sup> C.
  - 7.3.2 Concentration of sodium hydroxide should be 50 gm/lit (on 100% purity basis)
- 7.4 Drain the sodium hydroxide solution. Fill with water & drain. This operation of rinsing with water should be continued till the pH value of water at inlet & outlet ends are same.
- 7.5 Filling and circulation of inhibited hydrochloric acid solution for 6 hrs. (min)
  - 7.5.1 Temperature of inhibited hydrochloric acid solution during circulation should be 50 –60<sup>0</sup> C
  - 7.5.2 Concentration of hydrochloric acid solution should be 5 – 10 % by wt. HCL (on 100% purity basis) & Rodine – 213 special should be added in acid solution in the proportion of 1 lit. Rodine 213 (special) to 100 lits. 30 – 33% HCL However, exact concentration & duration of circulation of acid solution used shall be decided, based on visual inspection of carbon steel piping.


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- 7.6 Drain the inhibited HCL solution. Fill the system with 1 2 % solution of soda ash or caustic soda & circulate for 1 Hr. at 40 - 50<sup>0</sup> C.
- 7.7 Drain the neutralising solution. Fill with water & drain. This operation of rinsing with water shall be continued till the pH value of water at the inlet & outlet ends are same.
- 7.8 Filling & circulation of sodium hexametaphosphate solution for 2-4 hrs.
- 7.8.1 Concentration of sodium hexametaphosphate solution during circulation shall be 2–3% by wt.(on 67% P<sub>2</sub>O<sub>5</sub> basis) with pH adjusted to 5.50 – 6.50.
- 7.8.2 Temperature of sodium hexametaphosphate solution during circulation shall be 70–75<sup>0</sup> C.
- Note :- To prevent re-oxidation, the passivation solution must be introduced immediately after the flushing operation 7.7.
- 7.8.3 Drain the passivating solution without flushing with water.
- 7.9 Finally dry the circuit with clean dry air circulation.
- 7.10 The operations (7.1 to 7.9) in any one loop, when commenced , must be completed without interruptions.

## 8.0 OPERATION AND MONITORING


Satisfactory performance of the chemical cleaning depends on proper operation, monitoring & chemical controls during pickling operation. Following steps shall be considered during preparation of loops & operation.

- 8.1 Full bore flow shall be ensured while circulating various chemicals.
- 8.2 Vents shall be provided in all high points including large dia horizontal pipes for effective removal of air and acid fumes during cleaning operation. All vents shall be operated intermittently to ensure full bore flow throughout the operation and no air pockets shall be left in the system during pickling operation.

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- 8.3 Drain valves shall be provided at all low points for effective circulation of pickling solution and removal of sludge if any and no trapping of chemicals at the time of changing of chemicals.
- 8.4 Suitable high pressure pumps with necessary flow rate shall be provided to maintain good velocity (Preferably 1.0 M/sec) throughout operation and there shall be effective return of flow from all outlets and vent lines. Minimum two pumps shall be provided (one under operation & another standby). Preferably, pumps shall be of 40 – 50 M head with 75 – 100 m<sup>3</sup>/hr. flow rate. Actual discharge pressure of pump depends on loop arrangement and velocity to be maintained. The efficiency of pumps shall be checked periodically.
- 8.5 While preparation of loop, equipment or suction drums (C.S.) shall not be taken into circuit. Pickling of equipment or suction drums shall be done separately if required as per operation given in para No. 7.0.
- 8.6 Flushing shall be done with high velocity water in reverse direction for effective removal of dirt, dust, loose rust and any foreign matter etc.
- 8.7 The corrosion inhibitor efficiency shall be determined before pickling is started.
- 8.8 All chemicals shall be tested as per specification before use. The contractor shall also furnish the test certificates for all chemicals used for pickling operation.
- 8.9 Whenever acid is added the corrosion inhibitor shall be added first.
- 8.10 Standard solution for determination of iron in acid solution are required prior to pickling operation.
- 8.11 During pickling operation two carbon steel test coupons with mill scale shall be exposed, one inside the inhibited acid solution in the tank and another at outer of pipe. The mill scale free coupons shall be removed after acid circulation is over for determination of loss of weight. The coupons with mill scale are intended for indicating removal of mill scale after acid circulation and can be removed after completion of operation for final inspection.
- 8.12 Acid strength, total iron and ferric iron shall be determined every hour during operation. Periodically acid strength shall also be checked from all outlets, vents and drain lines.




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- 8.13 After acid picking and neutralisation, water flushing shall be carried out & continued till a pH value around 7.0 is obtained at outlets so that it facilitates the subsequent passivation with sodium hexametaphosphate.
- 8.14 During sodium hexametaphosphate circulation, presence of phosphate shall be checked from all outlets, vents and drain lines.
- 8.15 All data shall be recorded in check list during pickling operation including Chemicals consumption and observations, if any.
- 8.16 Segments of C.S. piping if any which can not be conveniently cleaned by chemicals circulation method may be cleaned by filling and/ or dipping/ immersion method. All the conditions of above operation s are generally applicable to this method.

## **9.0 CONTROLS FOR THE CLEANING PROCESS :**

- 9.1 All the specified parameters shall be followed during the cleaning process. All tests shall be conducted by the contractor to control the process.
- 9.2 The strength of the cleaning solution shall be checked for acid concentration every hour during the cleaning operation. If the strength is found to be below 5% by wt. The solution shall be drained in part and brought in the specified range of 5 – 10% wt. by addition of fresh acid.
- 9.3 The total iron and ferric iron contents of the cleaning solution shall be determined at the intervals of every one hour. The ferric iron content of the cleaning solution shall be monitored to avoid the attack on the metal. The total iron content shall not exceed 150 gm as Fe in 1 liters of the cleaning solution. The limits for iron and ferric iron shall not exceed 0.4% by wt. If the limits for total iron and ferric iron are attained the cleaning solution shall be drained in part and brought to the specified range by addition of fresh unused solution.
- 9.4 Iron stabilization & acid concentration shall be monitored to determine the completion of pickling.

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#### **10.0 PRESERVATION :**

The pickled and passivated lines shall be preserved in clean and dry condition. The necessary preservation procedure shall be followed.

#### **11.0 NEUTRALISATION :**

The necessary arrangement shall be made for complete neutralisation of pickling acid and disposal system. Prior to discharging of effluent in the sewer system ; it shall be analyzed and if necessary, additional chemicals shall be added for neutralisation so that discharge mixtures shall have pH value 7.0 in order to prevent any damage to paving manholes and sewers etc. The neutralised effluent prior to discharging shall conform to IS specifications.


#### **12.0 INSPECTION :**

The lines required to be pickled shall be inspected visually as seen from ends before pickling. After pickling and drying operation, visual inspection of loop shall be carried out at convenient location(s) as seen from ends to ensure the surfaces are completely clean, dry and free from rust giving uniform grey appearance on the original surface. The visual observations shall be recorded.

#### **13.0 SAFETY PRECAUTIONS :**

The alkali and hydrochloride acid solutions involved for chemical cleaning are corrosive for the skin and proper care shall be taken in the handling of the chemicals.

- 13.1 Adequate ventilation shall be provided during the acid cleaning operations to protect the health of workmen.
- 13.2 The handling of acid preparation bath etc. and heating must be supervised by a competent supervisor.
- 13.3 Safety goggles shall be worn by operators and workmen during pickling operation.

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13.4 Rubber aprons, protective boots & hand gloves shall be worn by workmen.

#### **14.0 TECHNICAL SUPERVISION :**

The chemical cleaning operation shall be conducted under close Chemical controls by the contractor and this operation shall be supervised by experienced and competent technical personnel as approved by PMC.

# **ANNEXURE - I**

## **PROCEDURE FOR TESTING**

### **INHIBITOR EFFICIENCY**

#### **1.0 TEST PROCEDURE**

#### **2.0 PREPARATION OF TEST COUPONS**

Carbon steel coupons of size 7.5 cm x 5 cm shall be cut from hot rolled (AISI 1020 or equivalent grade) steel strip or plate. The edge & sharp corners shall be ground smooth. A 5-mm dia hole shall be provided for suspension. The coupons thus prepared shall be used in the tests.

#### **3.0 IDENTIFICATION**

The coupons shall be hard punched with letters and / or number at one corner for identification.

#### **4.0 SURFACE PREPARATION**

For conducting the test to determine inhibitor efficiency, the coupons shall be free from mill-scale by grinding followed by polishing using emery paper. The final surface shall be bright using Oakey emery paper No. 0

Coupons for conducting the test for cleaning-solution, in removing mill-scale shall be in the as received condition of the surface i.e. with the mill scale on.

All the coupons shall be weighed separately correct to 1 mg using a balance.

#### **5.0 CLEANING SOLUTION**

The cleaning solution is the inhibited hydrochloric acid. The concentration of hydrochloric acid solution shall be 5-10% by wt. and inhibitor shall be added in the proportion of 1 litre Rodine 213 (Special) to 100 litre commercial hydrochloric acid (32/33% wt./wt.). The solution, thus, prepared shall be used for conducting the tests. The acid strength of the solution shall be determined following procedure based on the titration with standard alkali. The strength of the acid shall be in the range of 5-10 per cent by weight as specified.

#### **6.0 TEST FOR INHIBITOR EFFICIENCY**

Test shall be carried out in duplicates in glass containers preferably in one litre capacity beakers. One litre of cleaning solution each shall be transferred to beakers and the solution shall be heated to the maximum temperature in the specified range for the process. The coupons shall be completely exposed to the

action of the acid by suspension from the hole so that the upper edge shall be at least 1 cm below the liquid surface. The temperature shall be held as above throughout the duration of the test.

- 6.1 Identical test shall be carried out using uninhibited acid of the strength equivalent to that of the cleaning solution.
- 6.2 After the exposure of the coupons to the cleaning solution for the duration of actual cleaning, all the coupons shall be removed from the acid solution and clean in running tap water to remove acid and finally in distilled water. The coupons shall be dried and transferred to dessicator before weighing.
- 6.3 The weight loss of the coupons shall be determined and the corrosion rates calculated. The average corrosion rate of the coupons exposed to the cleaning solution shall be less than 3% (3 p.c.) of the average rate thus obtained for the coupons exposed to uninhibited acid. (i.e. percent corrosion inhibition shall be 97% minimum). Approval of PMC shall be obtained for the inhibitor efficiency obtained in the tests.
- 6.4 Test for Action on Carbon Steel in removing Mill-scale

Duplicate test coupons prepared as given in para 4.0 for this test, shall be exposed to the action of the cleaning solution in manner as given in para 6.0 for the duration and temperatures of the actual cleaning process. The coupons shall be cleaned as given in 6.2. The surface of the coupons shall be uniform grey and completely free from mill-scale. PMC shall approve the results obtained in this test.