CHEMICAL & OIL REFINING

Carry Out Maintenance Procedures

Performing minor maintenance

At the completion of this topic you must be able complete minor maintenance in accordance with standard procedures.

Minor maintenance of auxiliary equipment such as pumps is covered in the Unit *PROC 201 Operate Fluid Flow Equipment*

Minor maintenance

When the heat exchanger is isolated, minor maintenance such as clearing blockages, cleaning, lubrication, and oil level checks can be carried out in accordance with the Standard Operating Procedures and the Permit To Work system.

Maintenance of heat exchangers

Cleaning

For a heat exchanger to work efficiently, the heat transfer surfaces must be clean, and the flow passages must be clear of obstruction. Fouling is indicated by a gradual increase in the temperature difference between the two fluids over a period of time. This is usually accompanied by a noticeable rise in pressure loss at a given flow rate.

Fouling and scaling cannot be completely avoided. A cleaning program should be put in place to help insure the continued optimal, or near optimal, performance of heat exchangers. Exchanger cleaning methods are classified as either ***mechanical*** or ***chemical.*** Mechanical cleaning takes time and people, therefore it's preferable to use chemical cleaning.

Mechanical cleaning

Mechanical cleaning requires opening the exchanger. This involves the removal of the end covers and the tube bundle (plates in the case of a plate exchanger), then cleaning and then reassembly.

Damage of the exchanger components, particularly the tube bundle, is always a risk and great care must be taken.

If the deposit is on the inside of the tubes then an abrasive brush, either hand or power operated, can be used. Another technique involves the use of an abrasive bullet forced through the tube by compressed air. These bullets have the advantage of being able to negotiate tube bends, unlike other mechanical means.

Shell-side deposits require you to place the tube bundle in a specially designed cleaning cradle. This enable high pressure water or grit blasting to be carried out.

Chemical cleaning

With chemical cleaning it is important to identify the deposit in order to select the correct method for its removal.

Some of the common chemicals used to clean exchangers are:

- **Mineral acids**
  Hydrochloric acid is most widely used because of its low cost. It dissolves calcium carbonate (limestone) scale deposits. (If sulphuric acid was used to remove calcium carbonate scale, calcium solphate would form this is another insolubale substance). Otherwise, this would result in the formation of calcium sulphate, another equally insoluble substance.

- **Organic acids**
  Citric and formic acids are widely used - especially in steam generators where chlorine ions would cause problems with austenitic steels. Citric acid is used, in the form of ammonium acid citrate, to prevent the formation of insoluble ferrous acid citrates.

- **Alkaline agents**
  These agents have a detergent action and are capable of neutralising acids. Some examples are: soda ash, caustic soda, sodium silicates and tri-sodium phosphates.

- **Organic solvents**
  These are used where fouling is due to waxes and tars. They include kerosene, diesel fuels and trichloroethane. Organic solvents do not dissolve mineral deposits.

Offline cleaning
With shell and tube heat exchangers the removal of the header covers (or, in the case of the smaller heat exchangers - the headers themselves), will provide access to the tubes. Obstructions, dirt, scale, etc. can then be removed, using the tools provided by the heat exchanger manufacturer.

Techniques which have been used to remove foulants from heat transfer surfaces can be classified into two broad categories:

- mechanical
- chemical.

Mechanical cleaning techniques include:

- high pressure jet washing with or without the use of abrasives or chemicals
- hydro-steam cleaning
- sand and grit blasting
- rotary or percussive tools.

Mechanical cleaning techniques have the advantage of simplicity, with a corresponding ease in organising and executing the cleaning process, and minimal corrosive effects on the equipment being cleaned.

Chemical methods cannot completely clean blocked tubes when mechanical methods can.

The modern procedure of using fixed tube sheets and all-welded process lines restricts the use of mechanical techniques; so chemical cleaning methods, and the use of corrosion inhibitors are often preferred. However, chemical cleaning is not the answer to all foulants. Environmental concerns, safety issues, and possible damage to metal surfaces restricts the number of cleaning agents which can be economically used.

Most cleaning agents will present a potential hazard to equipment if they are still present when the equipment goes back online.

The majority of chemical cleaning is carried out in the following way:

- flushing to remove loose debris
- circulation and heating of water
- injection of cleaning chemicals
- circulation of cleaning chemicals
- discharge of cleaning fluid, and flushing
- treatment of metal surfaces to obtain an oxide layer resistant to corrosion
- flushing to remove all traces of cleaning chemicals.

Plate heat exchangers may be cleaned by unclamping the stack of plates and mechanically cleaning the surface of each plate as recommended by the manufacturers. The plate seals may require replacement from time-to-time and here the manufacturer's instructions should be closely followed.

Online cleaning
Online cleaning has the greatest potential advantage for a plant owner. There is the possibility of damage to the heat exchanger or downstream equipment, and this is the over-riding factor when any cleaning technique is being considered.

Mechanical techniques include methods such as injecting rubber balls into the cooling fluid upstream of the heat exchanger and collecting them downstream in a special filter. Also, high pressure and water jetting techniques are used such as: jet washing cooling water heat exchangers, de-slagging coal fired boilers and soot blowing off oil fired boilers.

Chemical methods of online cleaning are based on the use of a cleaning agent at a low concentration. This is a preventive long-term technique.

Successful clean-out requires the correct choice of a cleaning procedure for the foulant in question.

Repair of leaks
The method used to repair any leak is dependent on the design of the heat exchanger, the size of the leak, and the time available to carry out repairs.

Shutting down a plant for breakdown maintenance can be extremely costly and such decisions are not taken lightly. In the case of heat exchangers that have tubes as part of their design, a likely cause of a leak will be a tube. This tube could be part of a small heat exchanger, or part of a large water tube boiler. In the case of a small heat exchanger, this item of equipment may be able to be exchanged without shutting down the plant. In this situation, repairs to the equipment can be conveniently performed in the workshop. However, repearing a leak in a water tube boiler, would probably require a shutdown of the boiler and plant - if there is no steam supply.

For a leaking tube in a sizeable heat exchanger, it is possible to plug the tube at both ends to stop the leak. However, if the tube is plugged it is useless until it is properly repaired.

Repairing a tube properly, usually means replacing it. The removal of tubes is carried out by cutting one end off with cutting tools or a flame cutter, and then driving it from that end through the other (expanded tube). In the case of a welded tube, the welding must first be removed from the second end before attempting to drive the tube.

Tightening leaking flanges
It is preferable, if possible, to replace the gasket as the cost of the gasket relative to the leak is minor. If a gasket needs to be replaced, the flowline will need to be depressured, isolated and drained before work commences.

If it is not possible to replace the gasket, the flange can be tightened by:

- checking the alignment of the flange to see that the two flange faces are parallel
- reducing the tension on the flange bolts so that when the flanges are tightened

the two flange faces can be pulled into proper alignment
- tightening up the flanges by starting with the bolts furthest away from the leak, working from the opposite end towards the leak.

All minor maintenance procedures must be carried out in accordance with the Standard Operating Procedures, and the required Personal Protective Equipment must be worn

Activity OPS205A-32-1

Chemical removal of lime scale from the inside of tubes can be performed by the use of:

- ○ dilute hydrochloric acid.
- ○ hot water.
- ○ concentrated sulfuric acid.
- ○ organic solvent.

Activity OPS205A-32-2

Select two correct answers.
Regular maintenance on heat exchanger tubes is required to:

- ☐ keep operators busy.
- ☐ prevent blockages.
- ☐ increase production downtime.
- ☐ maintain heat transfer efficiency.

Send to Tutor Activity OPS205A-32-3

Briefly answer the following questions.

You might like to discuss these questions with other operators, your supervisor or your tutor.

1. Under what circumstances would a leaking flange require immediate attention? (Mention as many reasons as you can).
2. Explain why flanges are tightened starting with the bolts furthest from the leak.

Send this information to your tutor.

Send or Fax the information to your tutor.
Note: always include a cover sheet with required information, such as name of tutor, student, unit and activity number.

Next Task:

Preparing for operation

Navigation:

PMAOPS205A Operate Heat Exchangers
- Operate Heat Exchangers
- Respond to heat exchanger problems
- Carry Out Maintenance Procedures
  - Isolate and prepare for maintenance
  - Performing minor maintenance
  - Preparing for operation
  - Assessment tasks
- Contribute to Controlling Hazards
