

Catalyst Change-Out of Tubular Reactors

Introduction

CSI (Catalyst Services International) W.L.L. is a specialized company for catalyst change-out for tubular reactors with specialized unloading, inspection, cleaning, loading and DP measurement equipment. CSI started up in 2007 and employed an experienced (10-15 years) management team and developed state of the art equipment for catalyst change-outs, which is proven and procedures as prescribed by catalyst suppliers such as Shell/CRI/SD and any other procedure as introduced by our clients.

The catalyst change-out of tubular reactors consists out of 5 steps:

1. Unloading
2. Inspection
3. Cleaning
4. Loading
5. DP Measurement

1. Unloading

Removal of (inerts and) catalyst from the reactor tubes. The unloading activities will be carried out in an effective manner with maximal recovery of spend catalyst. CSI is able to use the following techniques during the unloading of the tubes:

- Vacuuming and air lancing ‘over the top’ using the fluidization method
- Prodding, ticking or poking of conventional tubes and thermo tubes
- Water jetting or drilling in those cases where tubes are completely blocked with fused catalyst or cokes

If required the catalyst, dust and inerts can be separated by screening, weighed, packaged and labelled to the customers specifications during or after unloading.



Foot pedals



hoses and steering rods



2. Inspection

Before grit blasting or other means of cleaning, the reactor tubes will be inspected by use of special designed camera in order to inspect the condition of the internal tube on its cleanness. The outcome of this inspection will recommend upon the following procedure to be followed.

3. Cleaning

In case the internals of the reactor must be freed of rust, polymers and/of other contaminations CSI is able to apply the following cleaning methods:

- Removal of dust by means of shooting a cleaning device (e.g. foam ball, brush, etc) through the tubes.
- Grit-blasting is required in the presence of rust, fused catalyst, polymers and other deposits present in the reactor tubes and domes. For the grit blasting special designed equipment is used as e.g. timers, blasting steers and nozzles.

4. Loading

CSI offers different methods in order to load catalyst in a controlled manner depending upon the packing of the catalyst and eventual requirements of the client, CSI is able to apply different loading methods whereas the control and removal of catalyst dust is critical for the overall quality and performance. It is essential that an equal flow through the individual tubes is established within the set parameters as specified in respective procedures (volume, height, flow and deviation). To offer its clients different preferred methods, which can change from client to client, CSI has the capability to offer its clients different catalyst loading methods:

- **Custom build loading machines**, especially designed for this unique application are electrical (42 Volt) driven, in order to drive a conveyor belt, by use of a self governing electric motor. Each machine is able to load six (6) reactor tubes simultaneously, whereas dust is controlled and evacuated at several critical points during the catalyst loading.
- **An orifice loading system (Inserts)** to be placed in the top section of the reactor tubes are used to reduce the reactor tube opening whereas catalyst will be swept over the reactor tube sheet resulting in catalyst to be loaded, piece by piece, into the reactor tubes. Once the reactor tubes are loaded up to the full extend, the inserts can be removed whereas the catalyst will shrink into the tube up to a desired outage (height).
- A **template** can be used, as convectional loading method, whereas a special designed plate with holes will be put on top of the tube sheet of the reactor. The holes of the template will match the top openings of the individual reactor tubes whereas the catalyst being swept over the template, is loaded, piece by piece, into the reactor tubes. Once the reactor tubes are loaded up to the full extend, the template will be removed and catalyst need to be evacuated out of each individual reactor tube up to the desired height or outage.

All the outages of catalyst loaded reactor tubes are measured and if required , corrected within the allowable outage range.



Custom made loading machines



hoppers for 'bag loading'

After the reactor tubes are loaded with catalyst, air blowing will be applied to all individual reactor tubes, in order to remove the catalyst dust, as much as possible, out of the reactor tube. The flow of air and the air blow duration can be adjusted as per the requirements of client.



Panel for dust blowing

5. DP measurement

CSI is able to carry out different measuring operations :

- CSI offers its clients especially designed pressure drop machines, in order to measure the homogeneity of the loaded catalyst bed for individual reactor tubes. The pressure drop of each tube is measured and electronically recorded. To ensure that all tubes are measured in identical matter, CSI uses specially designed digital pressure drop measuring equipment in combination with manufactured measuring rods, timer-controlled air supply systems and dry air.



DP measurement sticks



Panel DP measurement

Pressure drops readings are taken and electronically stored in a database.

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