

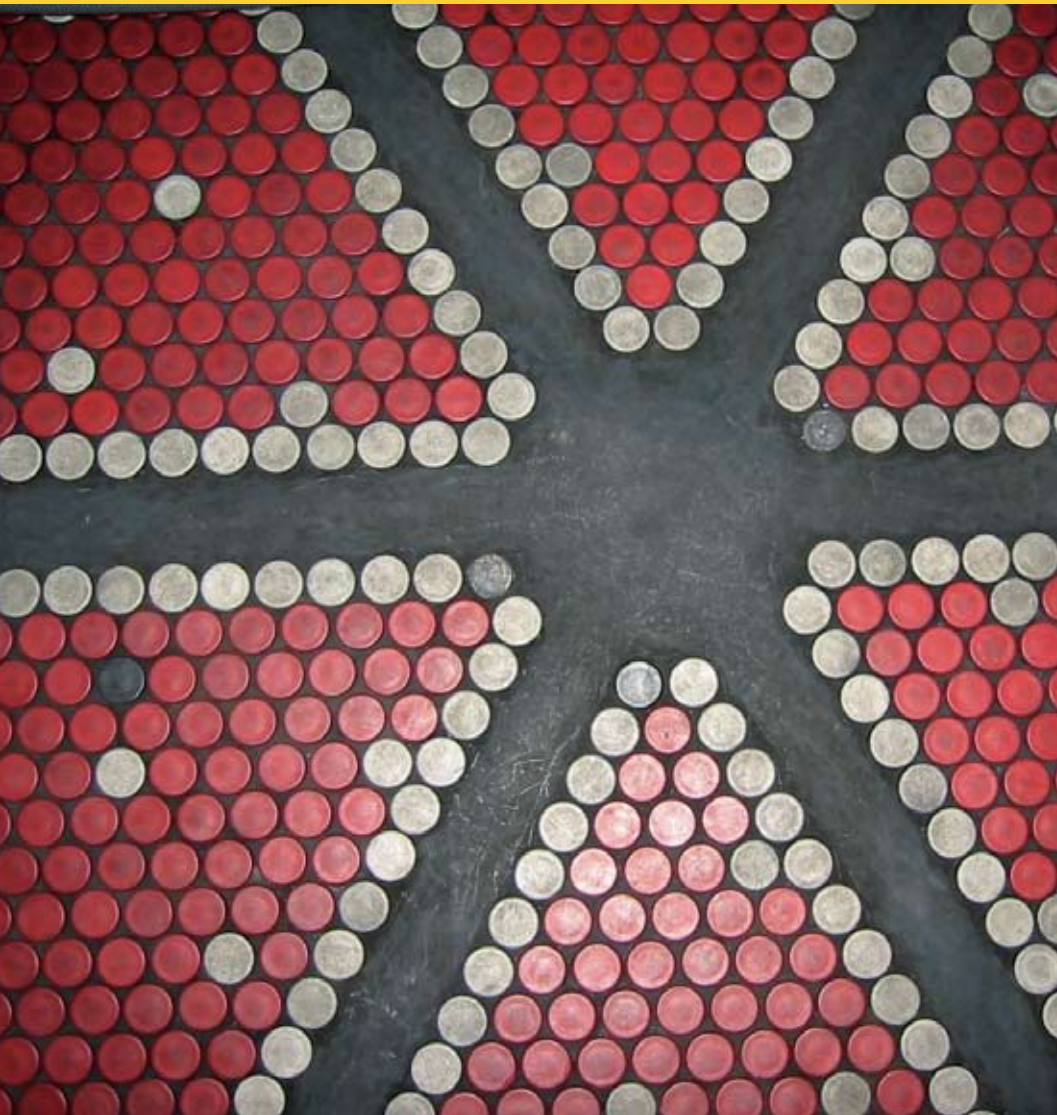


# Catalyst change out in tubular reactors

◀ Air lancing in progress

▼ Tube sheet

## Unloading Cleaning Loading Checking



### Tubular reactors

The Tubular Division of Mourik International is a specialised world wide contractor for catalyst changes in tube reactors.

We have many year's experience with various designs of reactors for the production of, for example:

- Ethylene oxide
- Methyl acrylate
- Acrylic acid
- Phthalic anhydride
- Maleic anhydride
- Acetylene
- Aromatics
- MSPO and GTL reactors

Depending on design and application, a typical tubular reactor may have up to 30,000 tubes, often with small diameters and lengths to 13 metres. Each tube is filled with one or more layers of catalyst of different type and shape.



▲ Vacuum setup

◀ A tubular catalyst handling work area

# Unloading

The most efficient unloading system is air lancing; a combination of pressurised air and vacuum. Catalyst particles are "loosened" with the pressurised air and vacuum removed. Following catalyst removal the tubes are de-dusted, inspected and if necessary cleaned.

Our unloading techniques currently consist of:

- Top vacuuming using the fluidisation system
- Physical removal by prodding of thermocouple tubes and/or fused catalyst.
- Water jetting in the event that tubes are completely blocked.

Where necessary, unloaded, spent catalyst can be de-dusted, screened, weighed and packaged to client specific requirements.



▲ Air lance device

# Cleaning

In the event that the reactor internals have to be cleaned to remove corrosion, polymers or other foulants, Mourik International offers the following cleaning methods:

- Wire brushing – a flexible, rotating shaft with specific brush attachments is lowered into the tubes.
- Pigging – individual tubes are cleaned using cylindrical abrasive objects. This is followed by a foam-ball to remove dust.
- Grit blasting – this is generally used when the internals are dirty due to fused catalyst or polymers.



▲ Air lancing, personel fully protected



▲ Grit blast equipment set-up

Unloading by:

- Prodding of small tubes and thermo well tubes
- Air lance system
- Direct suction

Removal/re-instatement of:

- Thermocouples
- Springs
- Clips
- Catalyst Support Disks (C.S.D's)

Catalyst handling techniques:

- Screening
- Weighing
- Pack and label
- Transport

Control of:

- Atmosphere, air conditioning
- Progress monitoring by use of coloured caps
- Working air – oil free compressors/coolers and driers
- Dust filtration
- Power distribution



▲ Installing gas caps



▲ Catalyst removal via direct vacuuming

Removal of:

- Dust with foam balls/swabs/rotating wire brushes
- Corrosion removal by use of abrasive moles ore grit-blasting
- Freeing of blocked tubes by drilling/H.P. jetting/TLE water jetting

Working air:

- Oil free compressors
- Coolers, driers and buffer manifolds

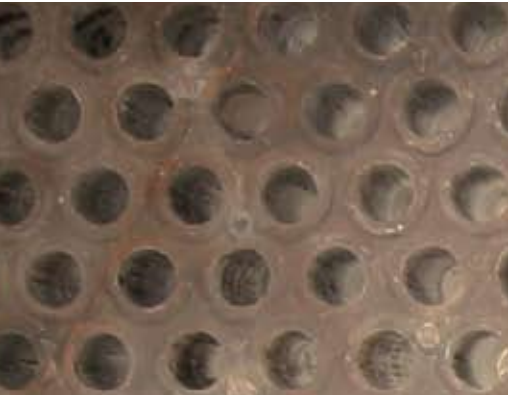
Cleaning of:

- inlet and outlet piping
- Man ways
- Domes
- Tube sheets



# Loading

The most important step in a catalyst change is the loading of fresh catalyst. It has a direct effect on catalyst life and reactor performance. Loading can be by our own unique G6 and G7 machines, template or inserts. In addition mechanical works such as replacing support springs, gas caps and catalyst support discs (C.S.D's) can form a part of our work scope as well.



▲ Tubes in need of cleaning



▲ Cleaned tubes



▲ TLE lance fixed to bottom of tube sheet



▲ HP TLE waterjetting



▲ Loading hopper, equipped with a dust extraction system



▲ Loading the catalyst by telescopic tubes



▲ G6 catalyst loading machine



▲ Loading pre-bagged catalyst



▲ Loading catalyst around the clock

## Loading of:

- Single catalyst types
- Multiple layers
- Foam balls/drums and big-bags
- Pre-weighed/pre-bagged
- Inerts in top and/or bottom of tubes
- Top fill
- Thermocouple tubes
- Pellets

## Loading by:

Catalyst conveying machines (type G6 or G7)  
 Templates/insert method  
 Sock distribution  
 Agitated trays

## Remove dust:

In funnel hopper  
 At the loading machines  
 Through air pulsing



▲ Progress control using coloured caps

# Checking

Loaded catalyst tubes are checked for density and pressure drop and corrected where necessary. Mourik International uses its own, in house developed and patented pressure drop measurement equipment. This will measure and record up to eight readings simultaneously. Digital readings ensure accurate measurement and make progress control and qualitative reporting possible.



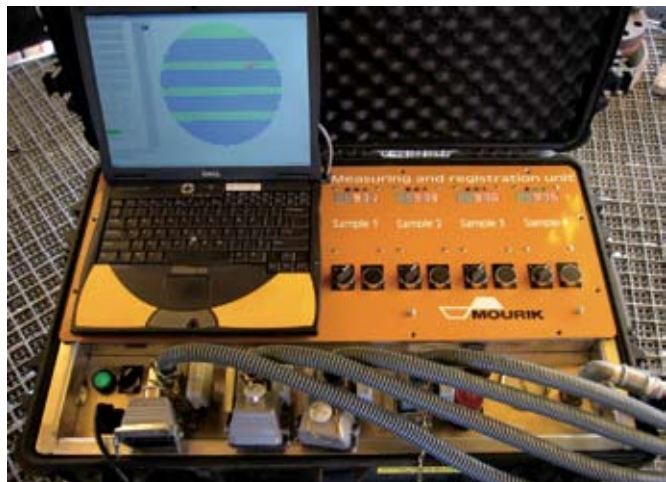
▲ Monitoring the progress of Pd measuring

## Pressure drop (Pd)

In order to determine the homogeneity of the catalyst bed, the pressure drop for each tube is measured. To ensure that all tubes are measured in an identical manner, Mourik uses specially designed Pd measuring equipment in combination with in-house manufactured measuring rods. Dry air is always used.

Pressure drop readings are taken:

- To calculate the permitted spread across the filled tubes. Values measured diagonally across 10% of the tubes, produces the basis for this calculation.
- To measure all of the tubes and where necessary correct to within the determined range.
- To calculate the mean value of the filled tubes.
- During the filling of the thermocouple tubes to achieve the calculated value as accurately as possible.



▲ Pd control box

Mourik measures the pressuredrop over each tube with use of an in-house developed and manufactured Pd device in a boxset. Each tube is checked by measuring the pressure drop (Pd), this data and correlating position is stored in a computer and will be used for reporting.

## Checking of:

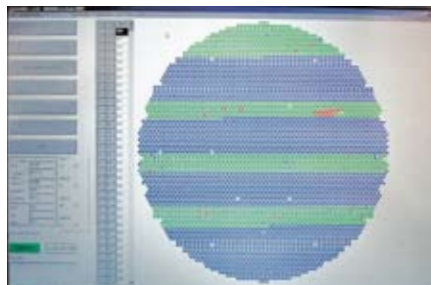
- Emptiness
- Clean internals
- Springs
- Outages
- Pressure drops (Pd's)
- Thermocouple tubes

## Pressure drop:

- Measurement
- Record values
- Row/tube position
- Margins
- Corrections
- Thermocouple tubes
- Correction factor

## Our Pd sets:

- Two, four or eight stick
- Mass air flow controlled
- Repetitive digital reading
- Tube sheet layout
- Progress control
- Patented



▲ Tubesheet layout indicating Pd values



▲ Pd measuring sticks



▲ Operating the Pd measuring stick



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