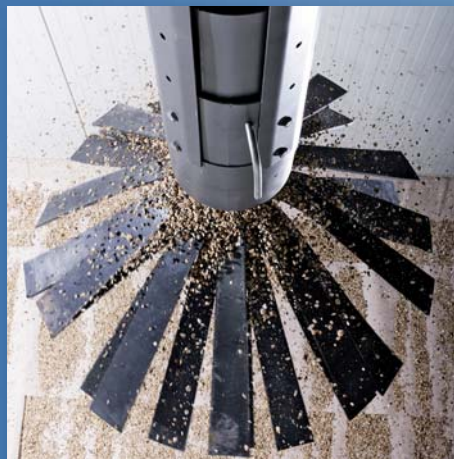
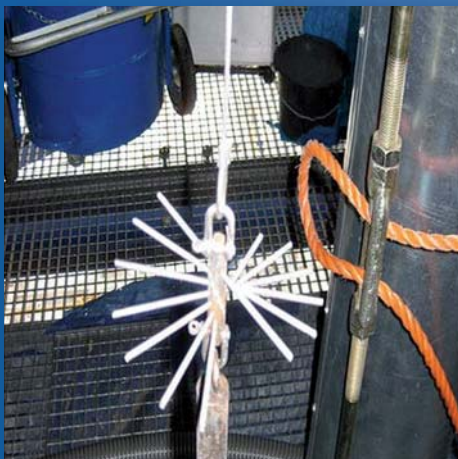




INNOVATIVE TECHNOLOGIES FOR
CATALYST HANDLING & INDUSTRIAL SERVICES





Technical development – R&D

RRT researches and develops special technologies for the catalyst handling sector. This concerns loading, cleaning and inspection technologies which can be used in vessels and reactors for customers in the petrochemical, chemical industry and by fertilizer manufacturers.

Our special equipment may be used anywhere where cracking furnaces, primary reformers and oil-fired heaters / furnace heaters may be operated.

All of the technologies and innovations which we have developed and which are used in customer projects are tried and tested:

- UDL uniform density loading for cracking furnaces with an inner diameter of 3.0"-10"
- Tubular loading for tubular reactors
- Edelhoff dense loading for fixed bed reactors
- Ammonia converter technologies for revamps
- Video inspection including testing of the remaining life for cracking furnaces / reformer furnaces
- Digital dP measurement for cracking furnaces reformer furnaces
- TubeCleaner Inside for primary reformers & furnace heaters
- TubeCleaner Outside for primary reformers & furnace heaters





Our specialists at the technology centre in Lauchhammer perform - together with our customers - project-specific tests and develop optimal technical solutions for subsequent production and use in customer projects.

Currently, RRT is developing a new procedure for the emptying of primary reformers to achieve time and costs savings of 10% in comparison to the established unloading systems.

Peter Richter, one of the RRT company founders and the innovator of various industry patents for the loading and cleaning of reactors, was trained by the innovator behind Unidense Technology and is still amicably advised by him. RRT's aim is to become one of the leading manufacturers for loading technologies on the international market.





UDL Uniform Density Loading

When loading cracking furnaces, it is crucial that every tube is loaded with exactly the same amount at the same speed and that a virtually consistent density is achieved.

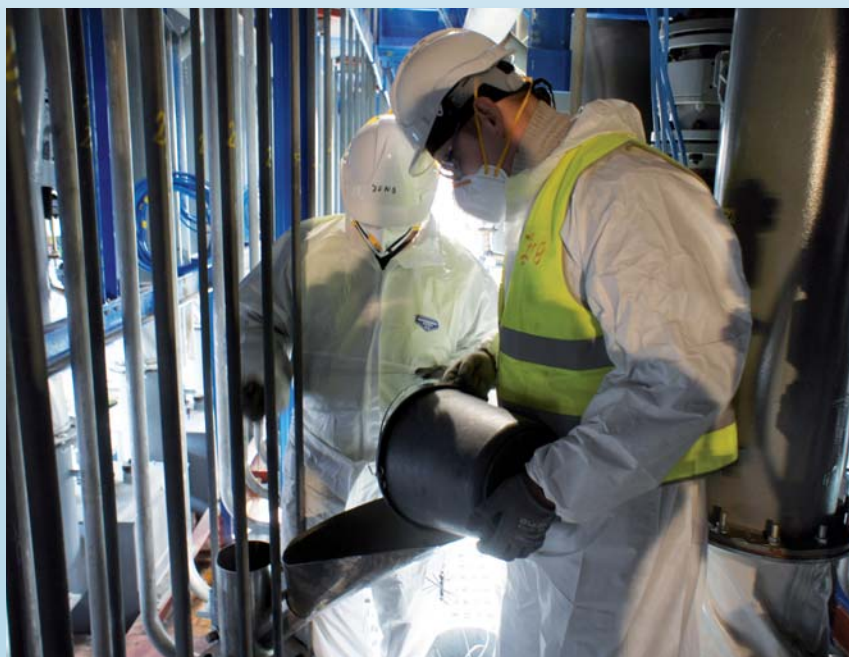
If the reactor is loaded using the conventional sock-loading method, hot spots will develop in certain circumstances due to an unequal gas flow rate, following which tears in the tubes may occur due to overheating. The degree of efficiency is also not optimum due to the widely differing density of the individual pipes.

In the case of sock loading, the loss of pressure is approx. $\pm 10\%$. Furthermore, prior to the works, the exact measured amount of catalyst must be prepared which means loading the catalyst into socks so that each tube can be identically loaded.

Our UDL uniform density loading technology - which we use in either its manual or automatic version - is easier, faster and better. The reactor loading carried out by using UDL manual loading guarantees a consistent and good loading result.

For the even more efficient and consistent automatic loading of all tubes, we recommend using UDL automatic.

You save up to 20% more time and the loss of pressure is just $\pm 3\%$.





Tubular loading for tubular reactors

The tubular loading technology is used for uniform loading of tubular reactors by using measurement tubes. Our improved loading technology enables us to achieve precise filling heights without the necessity of final vacuuming.

The measurement tubes have been specifically selected or manufactured for the catalyst to be loaded. In addition to the information already present, the correct length of the measurement tubes required for the prescribed free height is determined by means of tests. The ABS plastic is a cost-efficient and reliable material.

The whole loading surface is covered with the measurement tubes. Slow loading with catalyst prevents variations of the filling speed.

Fluctuations and the impact of tolerances are eliminated by customer-specific design of the measurement tubes, catalyst combinations and an active dust removal. The thickness of the perforated plate for material feeding is controlled via the adjustable ceiling inlet at the hopper. Vacuuming of the dust is carried out at the main supply line of the hopper; additional fine dust removal reduces the dust volume. Hopper and fine dust removal are equipped with slot screens.





E.DL Dense Loading for Fixed Bed Reactors

Since 2002, Edelhoff has constantly been further developing its tried and tested dense loading machine. The machine ensures that the catalyst material is dispersed in the reactor in a consistent, gentle and low dust way. This gives the required uniform and dense storage of the individual catalyst particles with a significantly higher loading volume.

The continuously variable regulation of feed quantities, the rotational speed of the loading motor and the length and design of the flexible, star-shaped product deflectors placed on several levels guarantee gentle and economic loading for any reactor bed size.

The high quality theoretical training and practical on-the-job training are consistently implemented for all reactor technicians – as we are well aware: the more adept the technician, the better the loading result. Our customers receive a well-engineered technical service without royalties.





Ammonia converter technologies for revamps

Ammonia is used for the manufacturing of fertilisers, plastics, fibres, explosives and intermediate products for dyes and pharmaceuticals. It is produced from hydrogen and nitrogen via a reaction with an iron oxide mixed catalyst.

As converter revamps only take place every 15 years and the catalyst is highly pyrophoric, only a few companies such as RRT specialise in this type of activity. RRT is the perfect choice for such work thanks to its comprehensive operational experience and its previous global projects with plants of various designs, such as Topsoe, Kellogg, INS, and Casale.

The work already starts with planning of the shutdown and any work activities involved with such. Besides the inerting and opening of the vessel, unloading of the

spent material, and loading of fresh catalyst, the revamp process also involves comprehensive mechanical work being carried out. This includes assembly and disassembly of reactor internals, repairs and welding work. Inspections are performed in cooperation with the customer. Any work inside the reactor is performed while using life support systems.

Time is money! That is why we employ experienced teams to organise, perform and finish projects in the shortest possible time. Our innovative unloading technology using modular vacuum containers enables rapid vacuuming of the spent material under nitrogen atmosphere, dumping of the spent material at the unloading site for evaporation, and subsequent forwarding to further processing.



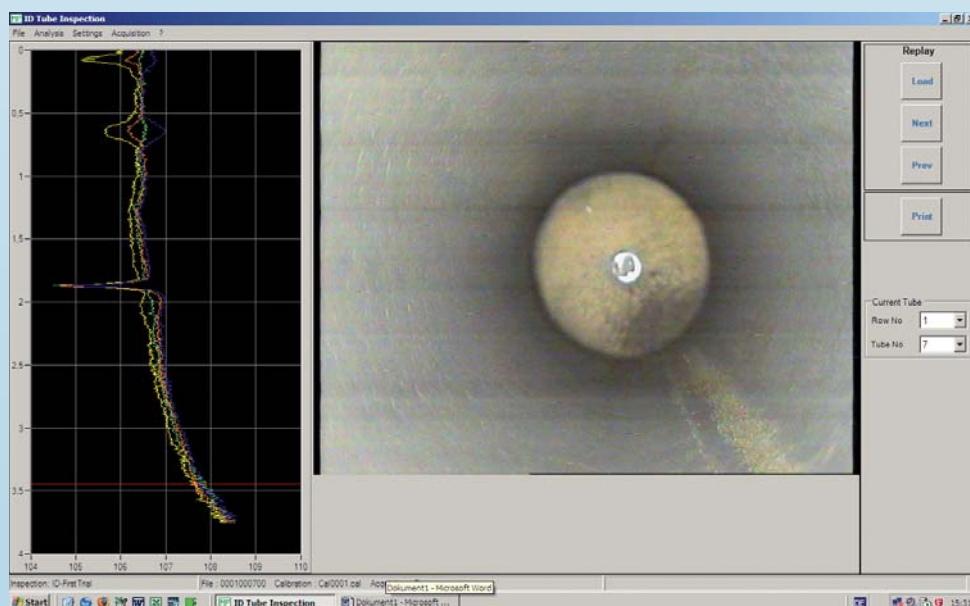


Digital dP Measurements

RRT uses digital systems for pressure drop measurements which cannot be outdone in terms of precision. The devices do not just stand out for their light weight and their ease of use. A safety appliance automatically cuts off the device in the case of excess pressure so that a high degree of occupational safety is guaranteed.

You can be assured that you will obtain the best measurements during every work phase. We measure the pressure drop:

- after emptying the tubes to see whether a free flow-through exists,
- per catalyst layer and type change and
- after the end of the work to determine whether the same pressure drop is found on all tubes.





RRT Video Inspection

After the reactor is emptied, all of the tubes are checked first of all. It is verified whether residual catalyst exists, whether the tubes are polluted with carbonates, which act as an isolator, and whether the support grid at the bottom of the reactor is free or damaged. Further measures are derived at short notice from the results.

We have a procedure that stands out as being time-saving and efficient. Video recordings of the individual tubes are continuously saved onto SD cards. While the first recordings are surveyed by site management, customer and catalyst manufacturer on a separate play-

back device, the RRT technicians continue to gradually deliver the further recordings. In this way, further decisions may be made and promptly implemented without interrupting the works.

Checking of the remaining lifetime

In cooperation with MP Magnetische Prüfanlagen, RRT has developed a tool which means that we can carry out an expansion measurement on every single tube. This means that the diameter is continuously measured, and

the smallest deformations caused by hot spots can be recognized. Compared to traditional external gauging, internal measurement delivers more accurate measurements which makes a decision with regard to the possible tube replacement easier for our customers.





RRT TubeCleaner Inside

Carbonate deposits and other deposits on the inner walls of primary reformer and furnace heater tubes lead to an impairment of the plant operation.

The RRT TubeCleaner Inside removes the hardest of deposits from the inner walls without damaging the tube. An air-driven motor actuates flexible soft brushes and hard rollers which force open carbonates; the deposits are extracted at the same time.

Before the cleaning works are started, 3 test tubes are cleaned. The customer can then subsequently decide together with our trained RRT personnel on-site and, if necessary, with the plant constructors or catalyst manufacturers, whether the cleaning results in the desired benefit.





RRT TubeCleaner Outside

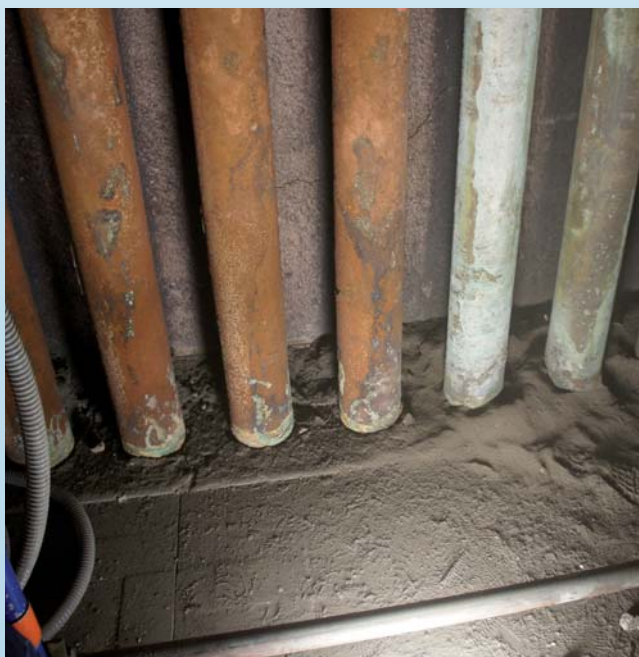
External tube cleaning with RRT TubeCleaner Outside is used on:

- furnace heaters which are heated with crude oil. Deposits / slick on the tubes block the heat transfer like an isolator.
- reformers which are fired with gas. Depending on the quality of the gas, sulphur may build up on the tubes and rust deposits are also common.

The RRT TubeCleaner Outside removes deposits without causing damage using rotating steel brushes. When the highest point is reached, a limit switch automatically shuts off the cleaning device.

A suction device removes the deposits and thus prevents contamination of workplace and environment.

Automatic external tube cleaning saves you personnel costs and the time required for scaffolding. You increase the efficiency and the life span of your tubes, improve safety by avoiding work at risky heights and protect the environment.





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