The Importance of the Right Maintenance Procedure for Heat Exchangers

Since 1961 Maus Italia core business has been developing new tools and technologies to facilitate maintenance and production of shell and tube heat exchangers. In particular, it has developed a complete series of tube bundle pullers and lifters, which fall into two categories: aerial and self-propelled, available for on-shore and off-shore operations in dangerous area.

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When a certain plant or factory starts its operations, all further activities are maintenance. In the past a repair / maintain principle was applied, meaning work was only carried out when equipment stopped functioning. Such a principle increases the risk for equipment and people on a daily basis.

The capacity of heat exchangers - and specifically shell and tube heat exchangers - to efficiently perform their function has a direct impact on the overall efficiency of power plants.

Fouling is an inherent problem that results in reductions in heat transfer and an increase in production costs. This requires an ongoing and annual heat exchanger cleaning and maintenance protocol.

The influence of maintenance costs on production costs can reach values higher than 30%, not to mention the costs incurred, which may duplicate the maintenance costs in critical production systems whose inadequate maintenance may put the operation safety at risk. The solutions proposed by Maus Italia allow not only to perform maintenance more effectively but also to transform it into an effective process that can contribute to the ultimate goal of business success. Overcoming a traditional approach to maintenance conceived as a limited action at operational level with a short-term perspective is necessary to implement this kind of change, so that it can take on a tactical-strategic role with a broad, medium-to-long term vision. This way of performing maintenance aims to transform it from a cost unit to a unit capable of producing results and opportunities. This step requires the development of a new organizational culture dominated by values such as integration, prevention, continuous improvement, knowledge, technology and innovation. All those values are the basis of Maus Italia's philosophy and consequently of the solutions proposed by this company.

Fig. 1 – Tube expander for shell and heat exchanger

Tube bundle maintenance

Since 1961 Maus Italia core business has been developing new tools and technologies to facilitate maintenance and production of shell and tube heat exchangers (**figure 1**). During its life-cycle this particular kind of heat exchanger is subject to fouling and scaling and should therefore be cleaned periodically. A light sludge or coating on the tubes greatly reduces their

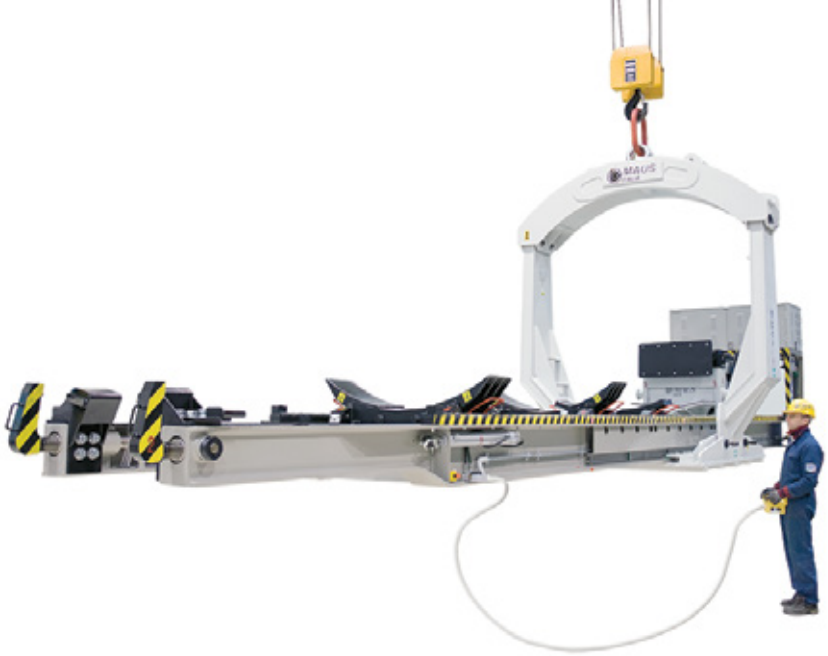

Fig. 2 – MEF express

efficiency. A marked increase in pressure drop and/or reduction in performance usually indicates they need cleaning.

After having carried out all testing operations and having excluded any possibility of partial reparation on site the bundle must be removed from the shell. When removing tube bundles from the exchangers you must make sure they are not damaged by improper handling. The total weight of the tube bundle must not be carried by the tubes only: it should rest on the parts designed to carry it instead, e.g. tube sheet, baffles or tube supports. This is a very critical phase, as adverse conditions may often arise when moving tons of tube bundles to tens of meters of height and the working activities must be performed safely.

To avoid any possible damage during such removal from the shell, a pulling device should be attached to the eyebolts screwed into the tube sheet. If the tube sheet does not display any tapped holes for eyebolts, steel rods or cables inserted through tubes and attached to bearing plates may be used. Do not handle the tube bundles with hooks or other tools which might damage the tubes. Baffles and support plates can be easily damaged by dragging a bundle over a rough surface.

Maus Italia's bundle pullers and lifters

Maus Italia has developed a complete series of tube bundle pullers and lifters, which fall into two categories: aerial and self-propelled. They are available for on-shore and off-shore operations and with a special treatment for operation in dangerous classified area:

- *aerial*: "MEF express" and "Bundle Tutor"; designed to be used with the help of a crane, it can reach all the work- ing positions accessible overhead;
- *self-propelled*: "MEF mobil" and "MEF Truck"; it has the advantage of avoiding the crane but clearly has a more determined and limited range of use.

During the extraction and transport operations it is essential that the tube bundle is not damaged or deformed. Maus Italia technical office has years of experience and invests thousands of hours in research and development to study customized solutions for every situation, geometry, size, area and position.

Fig. 3 – MEF express: aerial tube bundle puller

MEF express

MEF express (**figure 2** and **figure 3**) is a bundle puller entirely designed and manufactured by Maus Italia. The hydraulic hooking of the tube plate makes it possible to quickly insert and pull out the tube bundles when refineries experience a shutdown with a consequent work time reduction. The great solidity and sturdiness of the structure as well as its innovative improvements make this machine extremely reliable and safe. MEF express is produced in different standard dimensions according to the tube bundles weight, length and diameter. A portable console enables to remotely control all the operations with a consequent reduction in the needed personnel and increase in final safety margins. It is supplied with diesel or pneumatic motorization and as well as motors for hazardous classified working area (Atex).

Maus Italia studied a special version of MEF express to meet the need for the extraction of tube bundles on petroleum platforms and installations at sea on large vessels known as FPSO (Floating Production Storage and Offloading). The machine is a MEF express Navy produced for this purpose following the highest standards concerning shipbuilding. There are many similarities with the on-shore MEF express as a rapid extraction system. However, it is equipped with a special device that blocks any bundle oscillations due to sea swell. It is very compact and light, suitable for handling in small spaces and powered by a mobile power unit. This machine is designed to work in force 10 sea conditions.

MEF mobil

The MEF mobil tube bundle puller (**figure 4**) is designed for areas difficult to access and is completely self-sufficient, as it is presented as a global solution in petrochemical plants for the extraction of tube bundles. This kind of puller operates autonomously without the assistance of a crane for positioning and hoisting or trucks for transport to the tube bundle maintenance area after extraction. It is solid, robust and stable and it autonomously raises to a height of 4,2 m (166”), hence enabling to approach the heat exchanger in a rapid and precise way.

Furthermore, inserting the tube bundle after maintenance becomes extremely rapid and precise thus guaranteeing reduction in plant stopping times. Just like MEF express, MEF mobil also comes in the Navy version. In view of the unusual nature of its off-shore application, the dimensional details of MEF Navy are based on the designed installation specifications provided by the final client or engineer in change of the project in a spirit of close collaboration.

MEF Truck

MEF Truck, thanks to the original project of the telescopic rotating column, allows the quick pulling/inserting of the bundle. Once the truck is positioned, it is easy and quick to lift the extractor and to proceed with the extraction.

This system is particularly advised for the maintenance companies which operate continuously in the petrochemical plant field.

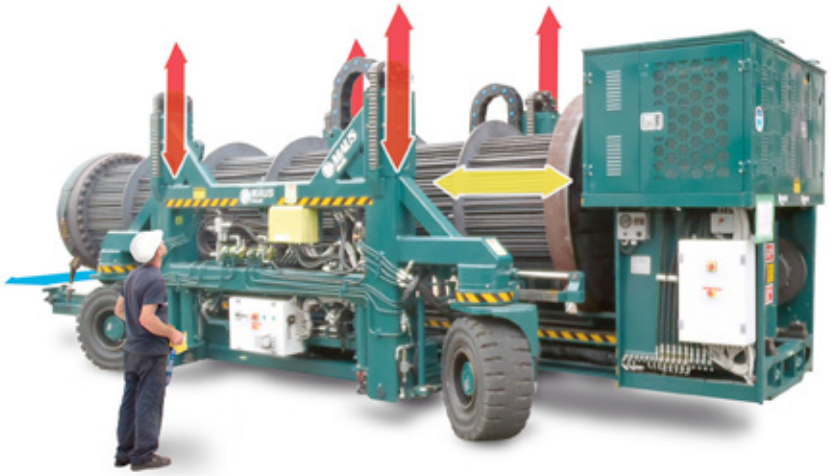

Fig. 4 – MEF mobil

The problem of moving tube bundles

Generally, during the lifting phase slings are used and if the distance from the OTL (Outside Tube Limit) to the baffle diameter is small, the tubes easily bend and consequently these break. If instead this distance is high the baffle deformation is obtained.

For this reason in 2017 Maus Italia designed and patented the Bundle Tutor (**figure 5**). This machine brilliantly solves the problem of grabbing and tube bundles lifting during handling (production / maintenance), while operating in total safety and eliminating the risk of damaging the baffles or crushing the tube bundle tubes. The independents adjustable cables of the Bundle Tutor ensures compensation for any asymmetrical positioning errors of the *saddle* bands located underneath the tube bundle. The bands and the central jaws ensure perfect balancing of the bundle along its longitudinal axis, preventing flections and deformations of the tube ends caused by the weight of the projecting portions of the bundle.

The Bundle Tutor features some independent telescopic hydraulic beams to ensure balancing and adaptation of the Bundle Tutor to the geometry of the tube bundle longitudinal extension Y: +1000 mm (39.4”) on each side.

It also has a symmetrical jaws opening and closing system relating to the axis of the tube bundle to ensure perfect centering (transverse opening X: +600 mm (23.6”) on each side.

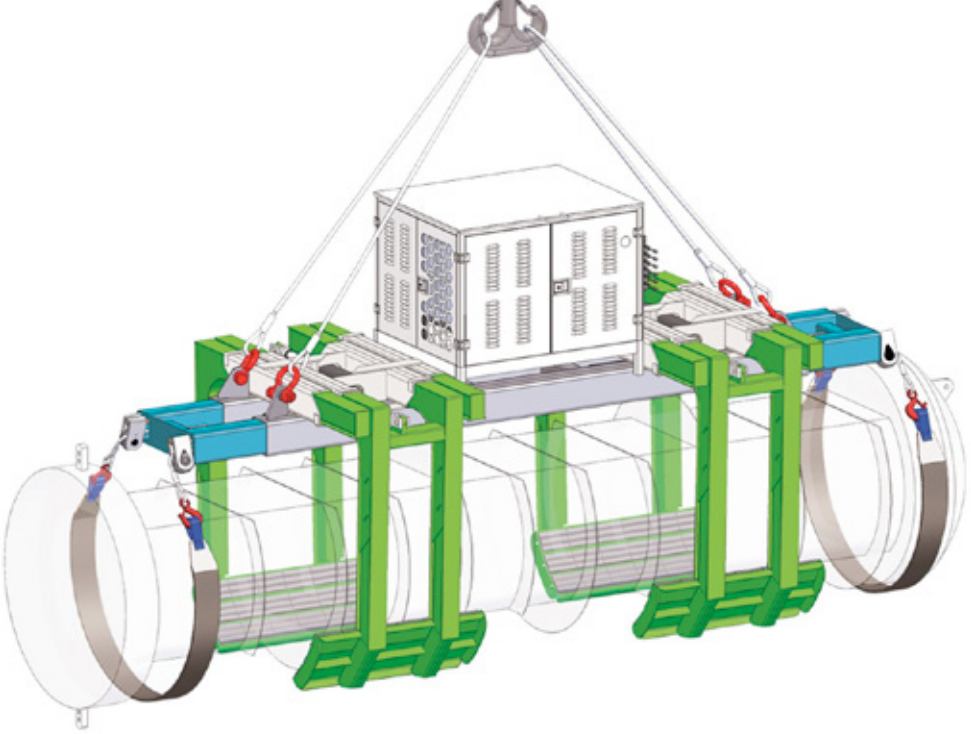

Fig. 5 – Bundle Tutor

The Bundle Tutor was designed to be used most frequently together with Maus Italia MEF series for tube bundle puller, such as the aerial MEF express and the independent mobile MEF Mobil in both on-shore and off-shore (Navy) models.

Conclusion

The aforementioned solutions represent a small part of what Maus Italia has designed over the years. The company has acquired an unrivaled experience in its field by designing and promoting the maintenance techniques best suited to any specific situation. Maus Italia promotes a continuous improvement in terms of technical performance of systems and maintenance costs, development and enhancement of maintenance skills as well as development / improvement of working methods hence constituting a reference point in its field.

Maus Italia started with the production of tube expanders and improved its business with the introduction of a series of machines that allow machines for bundle removing, tube removing, tube pulling, tube rolling and pneumatic tube cleaning.

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Now she is in the Executive Office of Maus Italia SpA.