Remote controlled vibration damper for flexible deployment with deep drilling machinery

by Benjamin Röcker, sales director TIBO Tiefbohrtechnik GmbH

Vibrations generated during machining processes frequently have a major effect on process safety and can, in the worst-case scenario, result in the total failure of the tool. Notoriously, deep drilling processes are by no means immune to this effect. The greater the drill diameter, the more potentially extreme the associated vibrations, which can even be transferred to adjacent plant under certain conditions, where they can also affect the production process. In such cases it is advisable to decouple the machine tool foundations from the rest of the environment as is commonly practised in similar situations in relation to heavy duty pressing plant and other vibration generating machinery.

In deep drilling operations based on the BTA process, the required boring tube is also considered to be part of the tool. The boring tube is clamped in the drill spindle of the deep drilling machine and the actual tool, the drill head, is screwed onto the end of the tube with the usually single or quadruple start thread (or sometimes a flange connection). To create a deep drilling, the length of boring tube must be at least the nominal bore depth plus the machine-related length reduction. Accordingly, the greater the bore depth, the longer the boring tube required and, as function of the increasing longitudinal elasticity of the tube, the greater the potential torsional and flexural vibrations. These vibrations need to be minimised as far as possible, as they have a direct effect on the drilling quality and on the operational life of the tool.

The objective

As a leading German manufacturer of deep drilling plant, TIBO Tiefbohrtechnik GmbH from Pfullingen in Baden-Württemberg decided to tackle this issue. TIBO set itself the objective of analysing existing damping systems and using these findings in terms of improvement potential to develop a high-quality product of its own. TIBO's well-known modular construction method for deep drilling rigs represents another fundamental design principle adopted for their new vibration damping system for BTA deep drilling plant, which will also benefit from the development of modular and universally deployable components.

The purpose of the vibration damper

The vibration damper is designed to support the boring tube, to absorb the torsional and flexural vibrations arising during the drilling process and to dissipate them into the subsoil via the machine base. As a rule of thumb, the number of vibration dampers required, and their positioning, can be calculated using the formula 40 x D (where D = diameter). This is the maximum distance at which a vibration damper must be positioned to support the boring tube in order to have a positive effect on the drilling process.

Construction types

In most modern deep drilling machinery, both the drilling tool with the boring tube

and the workpiece rotate in a counter motional manner. To this end, vibration dampers used in conjunction with a rotating tool need to be equipped with a roller bearing supported base frame. Within this base housing, a slotted damping cone is clamped to the boring tube by bracing it with bilaterally applied locking rings, which redirect the vibrations directly into the damping housing. Prior to starting the drilling process, the damping cone's defined pretension force is applied to the tube. In some cases, it may be necessary to adjust the tension force during the deep drilling operations due to a range of influences.

Generally speaking, there are two damping system types. In one, the damping cones are adjusted manually while the other type relies on a hydraulic or pneumatic control circuit. In manually operated dampers, the tension force is adjusted by hand using c-wrenches or hook spanners, which, under current safety regulations, is no longer permitted during operations in the case of new machines. Moreover, many of the damping systems currently available with hydraulic or pneumatic controls are extremely large and can only be deployed in a limited set of situations unless the operator chooses to acquire them in a range of different sizes in order to be able to cover the desired spectrum of drill diameters.

Compact construction, easy to operate

TIBO's newly developed vibration damper can be used to effectively pretension all commonly used boring tube diameters, which range from 11 to 382 mm. Special features of the system are a space-saving housing construction whilst covering an extensive range of drill diameters within a single frame size. The installed dimensions are oriented on those already established within the market, which are, to some extent, manufacturer independent. This enables the use of TIBO vibration dampers with third-party manufactured deep drilling machines with existing compressed air supplies. Additional oscillating weight can be easily affixed to the housing as required, and depending on the use case, to achieve even better damping properties. The pre-tensioning force is applied effortlessly via a proportional directional valve in conjunction with an ultra-sensitive precision controller, which also allows for precisely metered adjustments during the deep drilling operation. A touch panel display is also available for the new TIBO damping machines, which provides graphic visualisation and regulation of the tension pressures of each individual damper.

Bi-directional deployment capability

Another benefit of these dampers is their bi-directional deployment capability. They can be used for both ramming operations, for example solid drilling, core drilling, reaming, decortication or skiving and roller burnishing and traction operations (extraction drilling), without having to go to the considerable effort of rotating the damper housing through 180° as is the case with other makes.

True to TIBO's corporate motto, "modular", our vibrational dampers are universally usable and their wide deployment range is a reflection of our flexible approach to the manufacture of deep drilling plant.

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