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Dipl.-Ing. Torsten Bell
Dry Machining Technology
Network: "The main
advantages are economic."



This twin-spindle horizontal lathe was successfully converted to dry machining

The trend to dry machining – broadening applications

Dry machining is "in" – it is now quite some time since dry machining ceased to be an exotic speciality. Moreover, for many metal processing engineers it has matured to the point where it is one of the first options to be considered. Only when it becomes clear that neither dry nor near-dry machining are possible will wet machining be used for new acquisitions. Dipl.-Ing. Torsten Bell, spokesperson for the "Dry Machining Technology Network" ("Technologienetz Trockenbearbeitung") at the German Machine Tool Builders' Association (Verein Deutscher Werkzeugmaschinenfabriken, VDW), explains: "When dry machining or minimum quantity lubrication are under discussion, it is frequently said that ecological considerations take first place as the motive for process conversion. The fact is, however, that in the past dry machining has steadily been gaining significance on the basis of economic considerations, while aspects related to the physiological effects of the workplace and to ecology have rather taken second place."

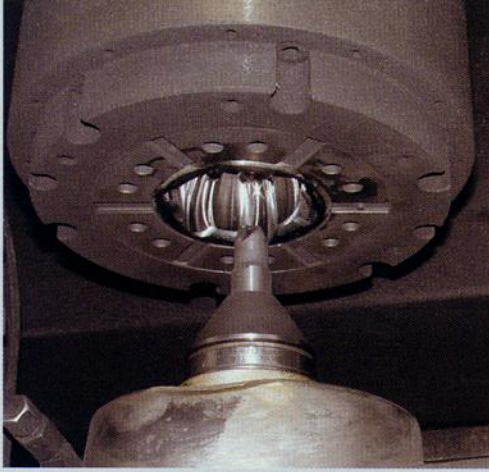
This rising importance is clearly reflected in the specially adapted machines and tools now offered on the market. Although dry machining is almost exclusively being applied in processes employing cutters with specific geometry, the majority of well known machine tool manufacturers are now offering suitable series machines. Even the construction of special machines cannot ignore this trend: customer demand for conversion to dry machining is now high on the agenda. In many metalworking shops the conversion of individual machines to dry processing, in most cases bringing significant improvements in cutting values, has provided the initial spark so that in many cases the operators have been encouraged to develop dry machining yet further.

The trend to dry machining has affected developments at tool suppliers even more clearly than it has the machine manufacturers. Remarkable technological advances have been achieved

in this field in recent years. It would not be an exaggeration to describe the tool manufacturers as the "real pathfinders" of dry machining. New cutting materials and new techniques have made a wide range of tools for dry machining available to today's user. Minimum quantity lubrication technology also overcame its teething problems long ago and offers a large number of devices with both external and internal coolant supply.

All the same, dry machining remains a very complex topic. Simply abandoning the cooling lubricant and ordering a new tool is not enough. Amongst the things that must be considered are the material being machined, the machine, the tool, the cutting material and coating, cutting conditions, minimum quantity cooling lubrication, machining operations and the properties of the component. It is vital to recognise that any one of these factors alone has the power to make dry machining impossible. Only considering the production process as a whole will lead to success.

The pacemaker and main user of dry machining is the automotive industry. The users of machine tools here play the role of system developers. That is to say that they "construct" an engineering system around a concrete manufacturing task in that they develop an entirely new technology in co-operation with the manufacturers of the machines, the tools, the clamping devices and so forth. In combination with what are usually very high piece counts, this approach offers a particularly good basis for the introduction of dry machining. Small and medium-sized companies here face altogether more serious implementation problems – nevertheless, there are examples of conversion to dry machining found outside the automobile industry. An East German manufacturer of standard parts machines its grooved nuts on twin-spindle horizontal lathes using 5% emulsion. Turning the outer and inner form of the blank part and the fabrication of the internal thread is implemented with two chucking processes.



Dry hard machining of homokinetic joints in the automobile industry

Clamped only once, high-precision hardened parts are turned and "grind-finished" dry



By rethinking the existing tool design and optimising the cutting parameters it has been possible to develop a reliable machining process, not even using minimum quantity lubrication. In addition, the processing time for each workpiece has been reduced by 35%. Optimisation of the technology brought with it a simplification of the range of tools, so that now only one tool supplier is necessary for this job.

The trend to dry machining – broadening applications

Further examples of the implementation of dry machining in a variety of industrial sectors:

- A supplier of automobile parts was able to reduce his costs in the machining of throttle device housings by 8 percent per component through dry milling, drilling and reaming.
- By machining a rail with holes and threads, a printing machine manufacturer was able to reduce the process time from 10.5 minutes down to 7.3 minutes through dry milling, drilling, thread tapping and reaming.
- An automobile manufacturer was able to reduce his cost per component by about 5 percent through dry generating the toothed wheels for a gearbox.
- The saving of cooling agent costs, reduced servicing and cleaning expense, and higher cutting values are the advantages of dry thread tapping and channel cutting on connecting pieces as quoted by a manufacturer of pneumatic cylinders quotes.
- Through dry milling and turning, a manufacturer of tools and moulds achieved a saving of 80% in the work required for machine servicing and cleaning, better surface qualities and shorter machining times.
- An aerospace company achieved "environmental protection with no financial disadvantage" through dry milling the parts it makes for integration into aircraft, and is pleased with the "reduced acquisition costs for machines without cooling agent systems".

- A power station manufacturer states that the benefits of quasi-dry milling of turbine blades are that "full-jet cooling does not reliably reach the active location – service life increased by a factor of 3 through minimum quantity lubrication".

In the gearbox manufacturing facility of another large automobile manufacturer, four vertical single-spindle machining centres now replace the former transfer line. On top of the benefits of dry machining that have already been mentioned, there is now the further advantage of increased flexibility.

The trend towards dry machining, in particular of hardened parts, is continuing uninterrupted. New application areas continue to be opened up. The drive towards dry machining is powered partly by issues of human and environmental compatibility along with the rapidly rising costs for the disposal of cooling agents, and also by the pressure to achieve further cost reductions in production processes. A heavy reduction in the use of cooling agents, even going as far as their full avoidance, promises both economic and ecological benefits. Dry grinding in combination with hard turning is already being applied with great success to mass production processes. If conventional turning and conventional grinding are combined, however, there is no promise of success. For this a process must be achieved in which the lowest possible level of energy is applied to the surface of the workpiece. In the so-called "grind-finishing" process, initial hard turning, without re-clamping the workpiece, is followed by a grind merely generating an appropriate surface. This is possible because the dimension to be ground off is reduced to a value in the range of mere surface roughness.

The extent to which dry machining will be used in the future and which areas will continue to be treated through wet machining will increasingly become a question of economics. Yet we can expect that the two processes will both be used for some time. One thing, however, is certain: dry machining has made significant gains in significance and acceptance – dry is "in".