

TECHNICAL INFORMATION

Coolants and its tasks

DEFINITION

According to DIN 51 385, coolants (or cutting fluids) are substances which are used for cooling and lubricating while cutting and forming materials.

In the metal-processing industry, coolants can be distinguished into water-miscible and non-water-miscible fluids.

The water-miscible coolants can also be distinguished into oil-free or oil-containing. The oil-containing coolants which are based on mineral oil or ester oil are by far more significant in use, with a usage rate of 95%.

The oil-containing coolants mixed with water are called oil-in-water emulsions. The oil-free coolants mixed with water are called coolant solution.

WHY WATER-MISCIBLE COOLANTS?

Cooling, as a primary requirement of the cutting fluid, is required in order to prevent a temperature rise at the working position and therefore to ensure optimum conditions for, amongst others, the dimensional accuracy.

The cooling substance should be able to conduct and therefore absorb the generated heat sufficiently but it should also be able to release it quickly in order to prevent itself from excessive heat-up.

These characteristics are determined by the specific heat capacity and heat conductivity.

	Mineral oil	Water
Specific heat capacity [kWs/kgK]	approx. 1.9	4.2
Heat conductivity [W/mK]	approx. 0.1	0.6

To achieve the same cooling effect, mineral oil becomes approx. twice as hot as the same amount of water. Considering the evaporation of water, mineral oil in fact becomes four to five times as hot as water. This means that the cooling characteristics of coolant emulsions, is due to the water.

The following points must be considered:

- flow rate of the emulsion
- form and direction of the coolant stream towards the working position

LUBRICATION

Lubrication is another primary requirement of the coolant and reduces the generated friction during the cutting process at the working position. For water-miscible cutting fluids, this task is ensured through the use of selected additives. There are 2 different types of additives:

- EP-additives (extreme pressure additives)
- AW-additives (antiwear additives).

EP-ADDITIVES

EP-additives react with the material under high pressures and temperatures at the working position, which prevent the welding of surfaces which are in contact with each other.

EP-additives require minimum temperatures and pressures in order to become effective.

AW-ADDITIVES

AW-additives generate a wear-reducing layer on the workpiece surface. The immediate contact of sliding surfaces is reduced.

With a few exceptions such as tooth machining, is it possible to cover the applications in the metal-processing industry with coolants by choosing suitable additives.

Besides cooling and lubrication, a modern coolant must meet further requirements:

- Storage stability
- Easy to mix in different water qualities
- Physical and biological stability in water-mixed condition
- Good corrosion protection
- Good rinsing and wetting behaviour
- Good behaviour against tramp oil (hydraulic/slide way oil)
- Good residue behaviour
- Good foaming behaviour
- Good compatibility with materials of the machines such as sealings, coatings and adhesives
- No health hazards
- Environmental compatibility
- Easy to treat and to dispose of