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CUTTING FLUID COMPOSITION OF CHLOROFLUORO- AND NITROALKANES

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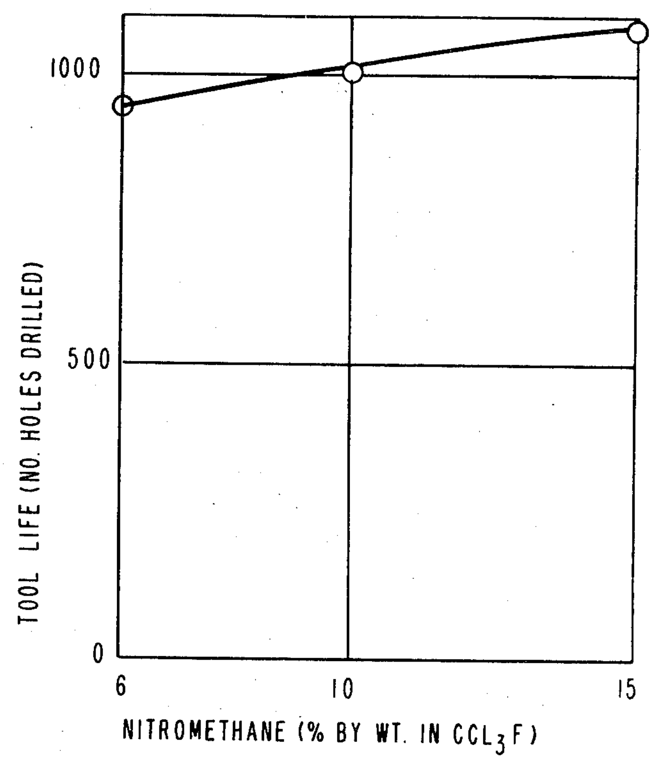

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CUTTING FLUID COMPOSITION OF CHLORO-FLUORO- AND NITROALKANES

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ABSTRACT OF THE DISCLOSURE

Cutting fluid compositions comprising trichlorofluoromethane or 1,1,2-trichloro-1,2,2-trifluoroethane and from about 6 percent to 15 percent by weight of a nitroalkane having 1 or 2 carbon atoms.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates to a cutting fluid composition comprising a chlorofluoroalkane selected from trichlorofluoromethane or 1,1,2-trichloro-1,2,2-trifluoroethane and nitromethane or nitroethane.

(2) Description of the prior art

The machining of metal has been carried out in contact with various fluids which are recommended and used as cutting fluids. Such fluids of the prior art comprise mineral oils, fats, fatty acids, soaps, sulfonated oils, waxes, oil-water emulsions, etc. More recently, fluorocarbons have been employed as cutting fluids as seen in McLean in U.S. 3,129,182.

SUMMARY OF THE INVENTION

The present invention is directed to a cutting fluid composition comprising a chlorofluoroalkane and a nitroalkane. The chlorofluoroalkane is either 1,1,2-trichloro-1,2,2-trifluoroethane or trichlorofluoromethane and the nitroalkane which is present in an amount of from about 6 percent to 15 percent by weight of the cutting fluid, has either 1 or 2 carbon atoms.

DESCRIPTION OF THE DRAWING

The figure is a plot of nitrolkane concentration in a cutting fluid composition of the invention versus tool life in drilling aluminum alloy. The curve represents the performance when the fluid feed rate was 2 lbs. (0.9 kg.)/hr. and the air flow rate was 2.03 standard cu. ft. (57.5 liters)/min.

DESCRIPTION OF THE INVENTION

The present invention comprises an evaporative cutting fluid composition which may be used in machining a metal, e.g., in drilling, routing, lathe turning, etc., said cutting fluid composition comprising a chlorofluoroalkane and from about 6% to 15% by weight of a nitroalkane having 1 or 2 carbon atoms. When machining a metal the manner of application of the cutting fluid, while not critical, is normally selected from two primary methods. The first method is the application of the cutting fluid as a solid stream and the second method is the application of the cutting fluid in droplet form, said droplets being dispersed and evaporated in a stream of compressed air by means of a misting nozzle. It has been found that the latter process prolongs tool life substantially more than does the solid stream method.

The chlorofluoroalkanes which may be used in the cutting fluids of the present invention are 1,1,2-trichloro-1,2,2-trifluoroethane and trichlorofluoromethane. The nitroalkanes are nitromethane and nitroethane. As will be seen in Examples 1 and 2, an increase in the amount of the nitroalkane in the cutting fluid composition from about 6% to 15% by weight, results in a correspondent increase in tool life. Tool life may also be increased by increasing the rate of application of the cutting fluid in both solid stream and misting nozzles.

All variables in the manner of application of the cutting fluid are not entirely independent. For example, the employment of large volumes of air permits the use of lesser amounts of cutting fluid of constant nitromethane content to obtain the same tool life.

Practical limits exist as well, for example, with misting nozzles, application of more than about eight pounds (3.6 kg.) per hour will cause fluid to accumulate on the work. Similarly, concentrations of more than about 15% nitromethane will cause nitromethane residues to accumulate on the work. The efficiency of the misting nozzle in terms of dispersion of the cutting fluid droplets in the air and the amount of co-dispensed air will naturally affect the accumulation of liquid on the work. Nitroalkanes of higher molecular weight than nitromethane although operable are more likely to accumulate on the work because of lesser volatility.

In utilizing the cutting fluids of the invention, the preferred cutting fluid composition is an approximately 8% by weight solution of nitromethane in trichlorofluoromethane. It is preferred to apply this solution at the rate of about 2 to about 6 lbs. (0.9 to 2.7 kg.) per hour through a misting-type nozzle with about 1 to about 2 standard cu. ft./min. (23 to 57 liters/min.) co-dispensed air. It is also preferable to adjust the rates of these two components within these limits according to the quality of the cutting machine and the particular operation.

Precautions should be taken in confined areas to protect personnel from the accumulation of excessively high concentrations of cutting fluid vapors. Standards set by the American Conference of Governmental Industrial Hygienists allow a Threshold Limit Value (TLV) of 1,000 p.p.m. for the fluorocarbon portion of the cutting fluid and 100 p.p.m. for nitroethane or nitromethane. The vapors of compositions within the range of this invention are of a lower order of toxicity and nonflammable. If gross evaporation occurs (more than 50% by volume), the composition becomes richer in nitroalkane until it eventually becomes flammable.

The following examples are intended to be merely illustrative of the invention and not in limitation thereof. Unless otherwise indicated, all parts are by weight.

EXAMPLES

The utility and effectiveness of the cutting fluid compositions of this invention were evidenced by a determination of the relative tool life in machining metal in contact with these cutting fluids.

Relative tool life was estimated in drilling by counting the number of holes drilled in aluminum alloy and in 316 stainless steel specimens under standard conditions before the cutting edge of the drill, as measured across the flutes at the circumference, had worn away 0.015 inch (0.038 mm.). This was measured by means of a scaled occular 40 power microscope.

The aluminum alloy test specimens consisted of two 4 x 6 inch (10.2 x 15.2 cm.), ¼ inch (6.35 mm.) thick plates of 7075–T6 aluminum alloy bolted together. The alloy is described in Chemical Engineer's Handbook, McGraw-Hill Book Co., New York, N.Y., Fourth edition, pp. 23–40 and is commonly used in the aircraft industry. The drill passed through both pieces, i.e., through 0.5 inch (12.7 mm.) of metal.

The 316 stainless steel test pieces consisted of four 4 x 6 inch (10.2 x 15.2 cm.), ⅛ inch (3.2 mm.) thick plates bolted together.

The test drills used in drilling the aluminum alloy were ¼ inch (6.35 mm.) No. 957 high helix twist drills manufactured by the Cleveland Twist Drill Co. of Cleveland, Ohio. Drills from a single lot were used in each test. The drills turning at 3640 revolutions per minute were advanced into the work at the steady rates shown in examples.

The drills used in drilling the stainless steel were ¼ inch (6.35 mm.) No. 817 Cobalt 135° split point drills also manufactured by the Cleveland Twist Drill Co.

Cutting fluid was delivered to the work by nozzles placed at an angle of about 30° to the work and directed to the drill hole. The nozzles used delivered mists consisting of droplets of a cutting fluid composition of this invention dispersed in a stream of compressed air.

The nozzle utilized in Example 1, hereinafter called the venturi nozzle, is manufactured by the Mamco Mfg. Co. of Seattle, Wash. The nozzle is characterized in that the cutting fluid is aspirated from the periphery of a central air channel. Cutting fluid is supplied to the periphery slightly upstream from the venturi inner nozzle through a sintered stainless steel ring, the inner portion of which was open to the air channel. Fluid was supplied to the outer periphery of the sintered ring. Air, mixed with aspirated cutting fluid droplets, is carried thereafter through an approximately ¼ inch (6.4 mm.) diameter tube about 1 inch (2.5 cm.) long where the mixture leaves the nozzle. Hereinafter the nozzle is referred to as the venturi nozzle.

A second misting nozzle which was used in Example 2 was the so-called "Spraymist" nozzle manufactured by the Bijur Lubricating Corp. of Rochelle Park, N.J. That company's flexible extension jet which they designate B–101 and their jet tip designated B–136 were used. The nozzle is characterized in that compressed air and cutting fluid are supplied to the nozzle head by means of two concentric tubes, the cutting fluid being in an inner tube and the compressed air in an annular space. The concentric tubes enter a spray head of relatively large volume from which the mixture exits at the opposite end through a 0.050 inch (1.27 mm.) diameter hole. There is considerable turbulence therein thus assuring good mixing. This nozzle is hereinafter referred to as the pressure-drop nozzle.

In these experiments with misting nozzles, compressed air was supplied to the nozzles at the pressures stated in examples. In the examples where air flow is stated, the flow was measured by a calibrated floating bob device. Fluid flows were measured by following the loss in weight of the supply tank and additionally by a calibrated floating bob device.

In the examples wherein standard deviation is stated, the average performance of three drills and the standard deviation in three parallel tests is reported.

EXAMPLE 1

This example demonstrates the utility of the compositions of the present invention as cutting fluids in drilling 316 stainless steel.

The conditions of the experiment were the following:

Application by: Venturi nozzle
Fluid flow rate: 4 lbs. (1.8 kg.)/hr.
Air flow: 2.4 s.c.f. (68.0 liters)/m
Fluid pressure: 40 p.s.i.g. (281 kg/cm²)
Air pressure: 80 p.s.i.g. (5.62 kg/cm.²)
Drill speed: 175 r.p.m.
Drill advance rate: 003 in. (0.076 mm.)/sec.

The results are shown in the table below.

TABLE

Cutting fluid	Performance (holes/drill)	Standard deviation
1,1,2-trichloro-1,2,2-trifluoroethane with:		
6.0 wt. percent nitromethane	13.0	0.0
10.0 wt. percent nitromethane	15.7	0.5
15.0 wt. percent nitromethane	17.3	0.5
Trichlorofluoromethane with 6.0 wt. percent nitromethane	51.5	0.5

EXAMPLE 2

Effect of nitromethane concentration in trichlorofluoromethane and other variables in high quality drill press drilling of aluminum

This example demonstrates the utility of compositions of this invention as cutting fluids in a high quality drill press and also the fact that performance, as reflected in extended tool life, depends on nitromethane concentration.

The conditions of the examples were:

Application by: Pressure drop nozzle
Drill advance rate: 0.006 in. (0.15 mm.)/revolution

In this experiment whose results are shown by the curve of the figure, fluid was applied at the rate of 2 lbs. (0.9 kg.)/hr.; air was co-dispensed in the experiment at the rate of 2.03 standard cu. ft. (57.5 liters)/min. It may be readily seen from this curve that an increase in nitroalkane concentration, between 6 and 15% by weight, results in a corresponding increase or extension of tool life.

The foregoing detailed description has been given for clearness of understanding only and no unncessary limitations are to be understood therefrom. The invention is not limited to the exact details shown and described for obvious modifications will occur to those skilled in the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A cutting fluid composition comprising a chlorofluoroalkane selected from the group consisting of trichlorofluoromethane and 1,1,2 - trichloro - 1,2,2-trifluoroethane, and from about 6 percent to 15 percent by weight of a nitroalkane having 1 or 2 carbon atoms.

2. A cutting fluid composition according to claim **1** wherein the chlorofluoroalkane is 1,1,2-trichloro-1,2,2-trifluoroethane and the nitroalkane is nitromethane.

3. A cutting fluid composition according to claim **1** wherein the chlorofluoroalkane is trichlorofluoromethane and the nitroalkane is nitromethane.

4. A cutting fluid composition according to claim **3** comprising trichlorofluoromethane and about 8 percent by weight of nitromethane.

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