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Experimental Investigation of Microbial Contamination of Nano Cutting Fluids with Cnt Inclusion

Dr. S.Narayana Rao[1]

[1] GITAM UNIVERSITY

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Abstract

The use of cutting fluids in machining is indispensible. However, the microbial contamination of the fluids limits their usage. In the present work nano cutting fluids with carbon nano tube (CNT) inclusion are prepared for use in Minimum quantity lubrication (MQL). Microbial contaminations of these samples are analyzed along with the fluids under stored condition over a span of one month, and the bacteria present in the fluid is isolated and identified to help provide the appropriate remedial actions.

Index terms—

1 I. Introduction

he prime function of cutting fluids stands is to provide adequate lubrication and cooling in metal cutting operations [1]. In addition, the fluids decrease adhesion between chip and tool and thus the adhesion wear. Lubrication also induces chip curl by reducing the rake contact length. Further, the fluids wash away the chips and keep the cutting region free.

Cutting fluids must offer some degree of corrosion protection. Freshly cut ferrous metals tend to rust rapidly because protective coatings have been removed by machining operation. A good metal working fluid inhibits rust formation avoiding damage to machine parts and the workpiece.

The coolant of the fluid prevents thermal expansions of the workpiece. Consequently, the fluids help in achieving longer tool life and better surface finish of the product. These benefits made the existence of the fluids in metal cutting operations for the last 200 years.

There are now several types of cutting fluids in the market, the most common of which can be broadly categorized as cutting oils or water-miscible fluids. Water-miscible fluids, including soluble oils, synthetics and semi synthetics, find 80 to 90 percent applications. Though cutting fluids have been looked upon as solution to reduce friction and temperatures in metal cutting, their usage is limited due to the various environmental and health hazards associated of the several problems associated, skin diseases caused to the workers, problems due to mist generation and used oil disposal deserve greater concern. Skin problems include mechanical trauma to the skin, infections, oil acne, folliculitis and irritant and allergic dermatitis [2,3]. Small cuts to the skin from metal shavings are common. These cuts can become infected as a result of contact with the fluids contaminated with microbial organisms. Basically, the microorganisms that develop in cutting fluids may be categorized as aerobic bacteria, anaerobic bacteria and fungi. Aerobic bacteria are extremely oxidative and adapt well to the wide variety of organic molecules found in cutting fluids. Their growth leads to emulsion separation, loss of lubricity qualities and corrosion. Cutting fluids cause skin diseases to the workers who are constantly exposed to them. Skin exposed to contaminated cutting fluids results in folliculitis. Workers also become vulnerable to other skin diseases like mechanical trauma to the skin, infections, oil acne and allergic dermatitis associated with the use of cutting fluids [4,5]. The primary microbial species commonly found in the cutting fluids belongs to the genus Pseudomonas [2]. This group has the reputation of being difficult to kill, having the broadest appetite and least nutritional requirement among any group of microorganisms. It may be noted that this bacteria is prevalent even in biocides used in hospitals. These organisms are highly oxidative, i.e. they grow best under

conditions of maximal aeration, multiplying typically every 45 minutes under ambient conditions of the fluid. This bacteria being highly opportunistic, is non-invasive, but causes infection through any open cuts or wounds those are common in a workshop.

In the present work, microbial contamination of the fluids was studied for stored samples of the cutting fluids since in MQL there is no question of recirculation of the fluid. The samples were stored in air-tight sterilized bottles and samples were tested weekly once.

2 T II. Experimentation

Cutting fluid samples with 0.5, 1, 2, 3, 4, 5% carbon nano tube inclusion were prepared to be used in Minimum Quantity Lubrication (MQL). To quantify microbial contamination, plate count method was adopted in the present work. Petri plates with nutrients needed for the growth of bacterial colonies were used for the purpose. In the present work, petri plates of nutrient agar (Fig. **??**) were used [6].

3 Fig. 1 Petri plate

The choice was made based on the aerobic nature of the bacteria. 0.1 ml of samples of cutting fluids were collected every week in a petri plate under laminar air flow. While transferring the fluid samples to the Petri plates, the samples are vulnerable to the bacteria present in air. To prevent contamination from air, the transfer of collected samples into the petri plates was done in a laminar air flow cabinet (Fig. 2) in the presence of a blue flame. The sample was incubated in a B.O.D incubator (Fig. **??**) at 37 0C for 24 hours. The number of colonies was counted after incubation. The test was carried out in triplicate for higher reliability of results. For identification of the bacterial species, the process was repeated using petri plates of different nutrients and other common tests like oxidase test were carried out.

4 III. Results & Discussions

Microbial contamination is one of the limiting factors in using cutting fluids. Several skin diseases in the workers are associated with the use of contaminated fluids. Growth in microbial contamination of the fluids was measured in the samples. Colony growth was observed colonies were observed (Fig. 4) for the samples. The samples were collected once in a week for four weeks.

5 Fig. 5 Microbial growth in samples

The results indicate least growth of microorganisms in sample with 2% inclusion. This may be attributed to the reason that the pH value of 2% inclusion is more hostile to the bacteria compared to 0%, 0.5% and 1% CNT fluids, but contains lesser nutrients to the microorganisms compared to 3%, 4% and 5% CNT fluids. Since excess CNT does not disperse well, it does not affect microbial growth.

In order to estimate the effect of the microorganism present in the fluid and decide on the remedial actions, identification of the organisms is mandatory. Isolation is done and the organism is tested in various culture media and the results are presented in Table **??**. As growth is observed only in cetrimide agar that is specific for Pseudomonas, the results lead to an inference that the organism present in samples is Pseudomonas genus. Being opportunistic bacteria, Pseudomonas though not invasive, has the tendency to aggravate in case of an injury or burns. There are about seventy species in Pseudomonas, majority of which have the ability to break down the oils (which can crucially affect the cutting fluid). The organisms utilize the carbon present in the oils as their source of nutrition and deteriorate the oil into inorganic compound. Pseudomonas has the ability to survive in hostile conditions and is not suppressed even by biocides (it is common to find Pseudomonas even in hospital disinfectants). Further, the use of biocides in the cutting fluids is subjected to several constraints imposed by the environmental regulations of various organizations. Thus the best way to control the growth of the bacterium would be to optimize the content of CNT inclusion.

6 IV. Conclusions

1. Bacterial growth was less in fluids with CNT inclusion. 2. 2% CNT fluid showed minimum growth 3. Bacteria was found to be Pseudomonas [1] [2] [3]

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Figure 1: Fig. 2

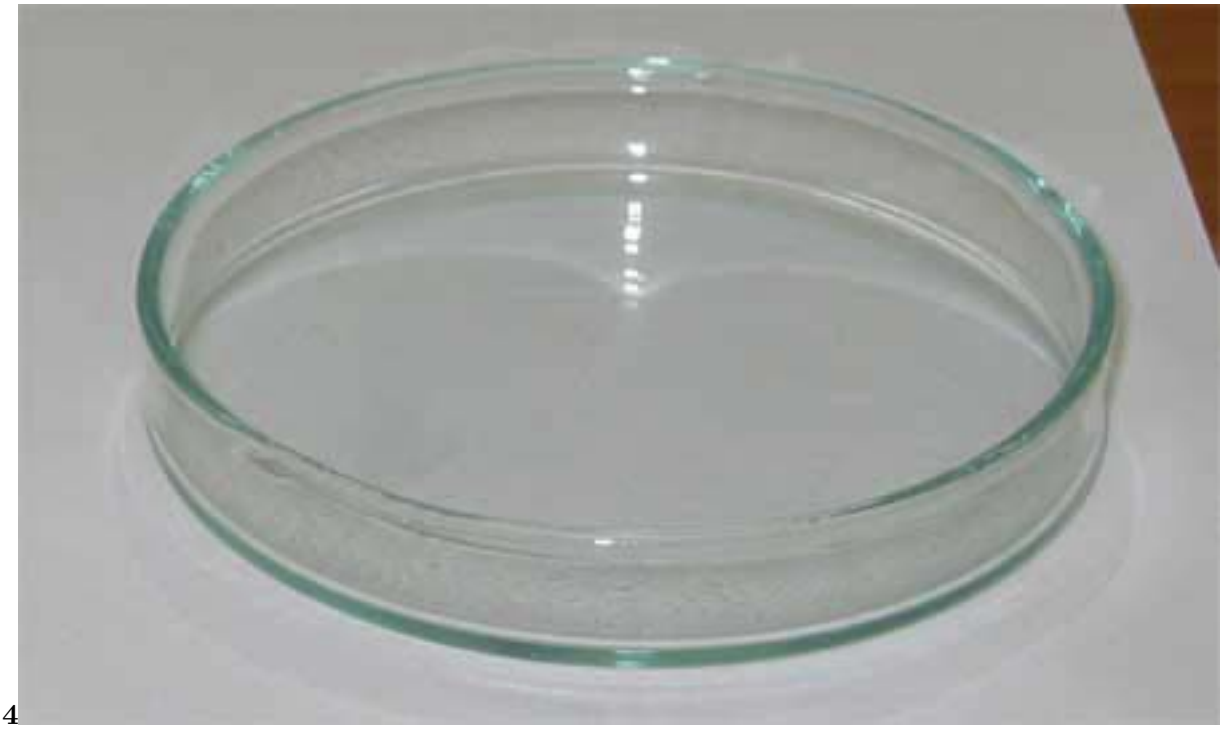

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Figure 2: Fig. 4

5

Figure 3: Fig. 5

		Cutting Fluid 0.50% 1% 2 % 3% 4% 5%	April 2011 Volume XI Issue IV Version I
H 2 S test Catalase Oxidase test Geletin liquefaction	SIM medium -no black coloration Bubble formation on addition of H 2 O 2 Pink color changing to maroon Geletin liquified	No H 2 S production Catalase positive Oxidase positive Gelatinase production	Global Journal of Research in Engineering
Growth in Macconkey medium	No growth	Growth observed only in Pseudomonas	
agar Mannitol salt	No growth	specific Cetrimide agar	
Cetrimide medium	Growth occurred		

Figure 4:

[Byers ()] Jerry P Byers . *Metalworking Fluids*, (CRC, USA) 1994. (1 st Edition)

[Cutting Fluid Management in Small Machining Operations ()] *Cutting Fluid Management in Small Machining Operations*, 1996. IOWA waste reduction Center, University of Northern IOWA

[Rossmoore ()] 'Evaluation Technique for Biodeterioration of Water-Miscible Metalworking Fluids'. H W Rossmoore . *Biodeterioration Research Techniques* 1976. (1) p. .

[Rossmoore ()] 'Microbial Causes of Cutting Fluid Deterioration'. H W Rossmoore . *Society of Manufacturing Engineers* 1974. MI.

[John and Harley ()] *Microbiology Lab Manual*, P John , Harley . 2007. McGraw-Hill Asia.

[Prevention of Skin Problems when Working with Metal Working Fluids, Safety Health Assessment Research for Prevention ()] *Prevention of Skin Problems when Working with Metal Working Fluids, Safety & Health Assessment & Research for Prevention*, 2001. p. . Washington State Department of Labor and Industries (Technical Report)