Coco Oil as Cutting Fluid for General Machining

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ABSTRACT

This study assessed the potential suitability of coconut oil in the production of cutting fluid by processing test composites of various mixtures. The experimental research was employed for the adequate interpretation of facts gathered. It was an experimental research since, coco oil will not mix thoroughly with water without emulsifier. Emulsifier as variable was manipulated and test results were analyzed if it would demonstrate efficiency and effective additive for the production of an alternative cutting fluid. Preliminary assessments of the compatibility of coco oil if it could mix with water using acacia powder and coco midrib ash as emulsifiers were conducted. Results showed that their physical and chemical properties were comparable with those of chemical-based cutting fluids available in the market.

RESEARCH METHODOLOGY

Design

The study involved the experimental method by determining the possibility of utilizing the coco oil as a substitute cutting fluid for general machining during the calendar year 2009. Actual cooking and mixing experiments of coco oil, acacia powder, and coconut midrib powder as an emulsifier, mineral water and surfactants was conducted. Laboratory test for its emulsion stability, lubricity, quality finish and tool life followed and was done at mechanical technology shop of Carlos Hilado Memorial State College, Alijis Campus.

The result of laboratory tests was used as data for statistical analysis. The Analysis of Variance was employed for the treatment in order to compare treatment means. The result comes with an alternative coco cutting fluid.

CONTENT

There are four basic types of cutting fluids or coolant. Each of it has distinctive features, as well as advantages and limitations. Selection of the right cutting fluid is ma0r-miscible fluids includes emulsifiable oils; chemical or synthetic fluids; and semi chemical fluids.

Chemical fluids are combinations of chemical fluids and emulsion. These fluids have lower oil content but a higher emulsifier and surface – active– agent content than emulsions, producing oils droplets of much smaller diameter. They possess low surface tension, moderate lubricity and cooling properties, and very good rust inhibition. Sulfur, chlorine, and phosphorus also are sometimes added.

Coconut oil, also known as coconut butter, is tropical oil extracted from copra (the dried inner flesh of coconuts) with many applications. Coconut oil constitutes seven percent of the total export income of the Philippines, which is also the world's largest exporter of the product. Coconut oil was developed as a commercial product by merchants in the South Seas in the 1860s (Wikipedia.com, 2010).

Coconut oil has a long shelf life compared to other oils, lasting up to two years due to its resilience to high temperatures. Coconut oil is best stored in solid form, at temperatures lower than 24.5 deg. C (76 deg. F) in order to extend shelf life. However, unlike most oils, coconut oil will not be damaged by warmer temperatures.

Fractionated coconut oil "is a fraction of the whole oil, in which most of the long-chain triglycerides are removed so that only saturated fats remain. It may also refer to as "caprylic/apric triglycerides" or medium-chain triglyceride (MCT) oil because mostly the medium-chain triglycerides caprylic and capric acid are left in the oil. Because it is completely saturated, fractionated oil is even more heat stable than other forms of coconut oil and has a nearly indefinite shelf life. (Wikipedia.com, 2010).

Refined coco oil is referred to in the coconut industry as RBD (refined, bleached, and deodorized) coco oil. The starting point is "copra", the dried coco meat. Copra can be made by smoke drying, sun drying, or kiln drying. The unrefined coco oil extracted from copra called "crude coco oil" is not suitable for consumption and must be refined (Wikipedia.com, 2010).

Coconut oil (CNO) production accounts for 57% of world's lauric oil output. This implies that the number of bearing palms in the country is abundant in terms of supply in the production of coconut oil and is therefore enough for the processes of coco cutting fluid.

Coco oil is used in the processing and distributed in the different products as raw material. Production of food products such as margarine, shortenings and filled milk and the manufacture of soap, detergents, toilet articles, shampoos and cosmetic industries both for local and international markets consume 40% of the total coco oil demand. The Production of plasticizers, pharmaceutical products, fatty alcohol, fatty acids and fuel has an 18% share in the total production.. While 3% are used domestically either in household and other needs (Wikipedia.com, 2010).

CHEMICAL PROPERTIES

Coco oil consists of about 90% saturated fat. The oil contains predominantly medium chain triglycerides, with 86.5% saturated fatty acids, 5.8% monounsaturated fatty acids, and 1.8% polyunsaturated fatty acids. In the saturated fatty acids, coconut oil is primarily 44.6% lauric acid, 16.8% myristic acid and 8.2% palmitic acid, although it contains seven different saturated fatty acid as oleic acid while its only polyunsaturated fatty acid is linoleic acid.

Unrefined coconut oil melts at 20-25°C and smokes at 170°C (350°F). Refined coconut oil, meanwhile, has a higher smoke point of 232°C (450°).

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This implies that coco oil mixed with an emulsifier as acacia powder and burnt coco midrib powder are feasible materials for cutting fluid because of the presence of the chemical properties found in them.

Comparative Information on Cutting Fluid

Material Component	Synthetic (Chemical Oil)	Coco Oil (Natural Oil)
Type	Emulsifiable	Emulsifiable
Efficiency	Highly Efficient	Efficient
Uses/ Application	General Machining	General Machining
Effect to human skin	Irritant (if not used properly)	Non-irritant (natural oil)
Effect on Disposal	Negative effect to the environment	Environment friendly
Cost	P1,550.00*/Liter	P575.00/ Liter

*Current cost in the market.

Table 1. The Composition of four (4) different Treatments

	Coco Oil (ml)	Mineral Water (ml)	Acacia Powder (grams)	Coco Midrib Powder (grams)	Chemical Surfactants (ml)
T1	100	50	25	0	0
T2	100	50	50	0	0
T3	100	50	0	50	0
T4	100	50	25	0	75

Table 2. Efficiency of Coco Cutting Fluid

Treatment	Rating (Average)			Total	Average Mean
	Drilling	Grinding	Turning		
1	4.75	4.5	4.5	13.75	4.58
2	3	3	3	9	3
3	2.5	2.5	2.5	7.5	2.5
4	2.75	2.75	2.75	8.25	2.75

Table 1 showed the composition of four (4) different treatments. Coco oil, mineral water and chemical surfactants were measured using graduated cylinder while acacia powder and coco midrib powder were weighted in a dial-o-gram flat form balance. Each treatment was mixed and treated separately. The treatments were applied and used in actual testing in drilling, turning and grinding respectively.

Table 2 presented the efficiency of coco cutting fluid. To measure and evaluate the efficiency of the four treatments, a group of invited ten (10) instructors and ten (10) selected students were made to observe, evaluate and rate according to emulsion stability, lubricity, quality finish and tool life. Each treatment was used and applied as cutting fluid in drilling, grinding and turning. Ratings were recorded and interpreted statistically.

Each application was rated as follows:

Descriptive Rating	Numerical Value	Main Score Ranges
HE – Highly Efficient	5	4.50-5.00
E - Efficient	4	3.50-4.49
ME - Moderately Efficient	3	2.50-3.49
LE - Less Efficient	2	1.50-2.49
NE - Not Efficient	1	1.00-1.49

Laboratory Tests included the actual application of cutting fluid in drilling, grinding and turning. The evaluation rated by the instructors and the students were tallied and interpreted. These served as basis for the statistical analysis and interpretation.

Table 3. The Performance of Coco Cutting Fluid in Drilling

COCO CUTTING FLUID IN DRILLING	REPLICATION				TOTAL	MEAN	DESC. RATING
	1	2	3	4			
Emulsion Stability	4	4	3	3	14	3.50	E
Lubricity	5	3	2	2	12	3.00	ME
Quality Finish	5	2	2	3	12	3.00	ME
Tool Life	4	3	3	3	13	3.25	ME
TOTAL	18	12	10	11	51		
MEAN	4.50	3.00	2.50	2.75		3.188	ME

Table 4. The Performance of Coco Cutting Fluid in Turning

COCO CUTTING FLUID IN TURNING	REPLICATION				TOTAL	MEAN	DESC. RATING
	1	2	3	4			
Emulsion Stability	5	4	3	2	14	3.50	E
Lubricity	5	3	4	3	15	3.75	E
Quality Finish	4	4	2	2	12	3.00	ME
Tool Life	5	3	2	2	12	3.00	ME
TOTAL	19	14	11	9	53		
MEAN	4.75	3.50	2.75	2.25		3.313	ME

The coco cutting fluid was found out to be efficient in emulsion stability with a weighted mean of 3.50 and moderately efficient in lubricity, quality finish and tool life with a weighted mean 3.0, 3.0 and 3.25, respectively. The overall performance of coco cutting fluid in drilling as reflected in Table 3 was moderately efficient with a weighted mean of 3.188. This suggests that coco cutting fluid can be an efficient alternative fluid in drilling.

The efficiency of coco cutting as alternative fluid in drilling was tested and the results revealed that it was efficient in lubricity with a weighted mean of 3.75 and likewise efficient in emulsion stability with a weighted mean of 3.20. It was moderately efficient in quality finish and tool life both with weighted mean of 3.00. The overall efficiency of coco cutting fluid as alternative fluid in turning was 3.313 or moderately efficient as reflected in Table 4. This observation is a good manifestation that coco cutting fluid can be a good substitute cutting fluid in turning.

Table 5. The Performance of Coco Cutting Fluid in Grinding

COCO CUTTING FLUID IN GRINDING	REPLICATION				TOTAL	MEAN	DESC. RATING
	1	2	3	4			
Emulsion Stability	5	4	4	3	14	3.50	E
Lubricity	5	3	3	2	13	3.25	E
Quality Finish	4	3	4	2	13	3.25	ME
Tool Life	3	3	3	2	11	2.75	ME
TOTAL	17	11	14	9	51		
MEAN	4.25	2.75	3.50	2.25		3.188	ME

Table 5 presented the performance of coco cutting fluid in grinding. It was observed that coco cutting fluid was efficient in emulsion stability with a weighted a mean of 3.50 and moderately efficient in lubricity, quality finish and tool life with weighted means of 3.25, 3.25 and 2.75, respectively. The overall effect of coco cutting fluid in grinding was moderately efficient with an average mean of 3.188. This implies that coco cutting fluid was a good substitute cutting fluid in grinding.

The figures below describe the steps in preparing Coco Cutting Fluid.

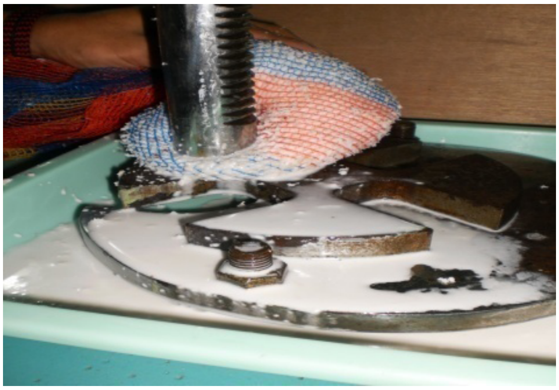
Figure 1. Selection of Coco Fruits

1. Select coco fruits from ten (10) to twelve (12) months of age. Matured coco fruit produces substantial amount of coco milk.

Figure 2. Grating of Coco Meat

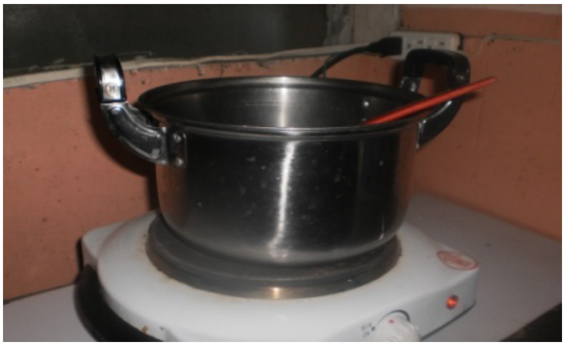
2. Grate coco meat using electric coco grater. The finer the granules the ease of separating the coco milk *"gata"* from the grated coco meat.

Figure 3. Separating Coco Milk



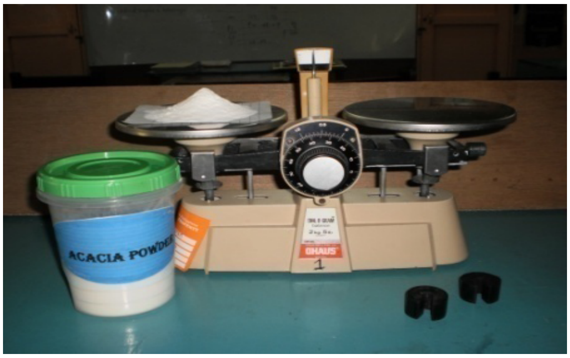
3. Put a cup of ground coco meat in a clean nylon screen. With the use of a mechanical press, gently press the pouch with the shaft downward to separate the coco milk.

Figure 4. Cooking of Coco Milk



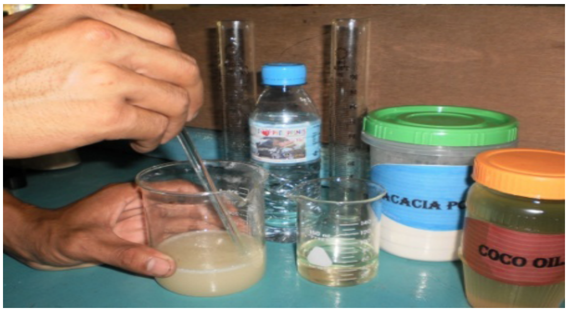
4. In a clean casserole pour coco milk. Cook for at least one (1) hour. Stir occasionally until coco oil is produced.

Figure 5 .Weighing needed Amount of Acacia Powder



5. Needed amount of acacia powder can be well achieved by using of dial-o-gram plat form balance.

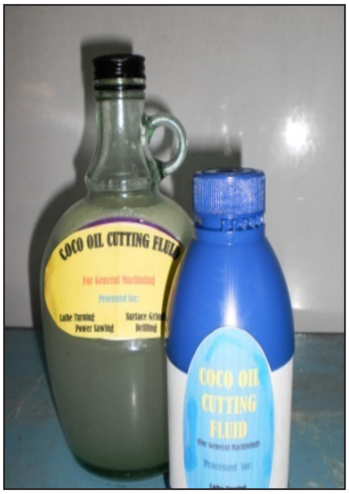
Figure 6. Mixing the needed materials: coco oil, acacia powder, and mineral water.



6. Pour twenty five ml (25 ml) coco oil in a beaker. Add acacia powder gradually, stir continuously. Add mineral water gradually. Repeat until all the materials were mix thoroughly.

7. The mixture is ready for use as cutting fluid by adding three to five (3 -5) parts of tap water. Mix thoroughly.

Figure 7. The Finish Product: Coco Oil as Cutting Fluid for General Machining



Applications:

Figure 8. Coco Cutting Fluid is used in metal work pieces in lathe turning.

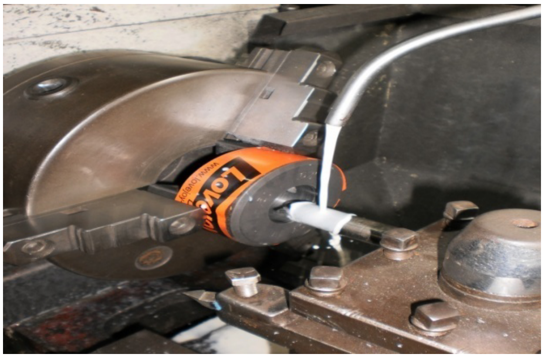


Figure 9. Cutting thick cross sectional steels can be efficiently cut with the use of Coco Cutting Fluid manually.

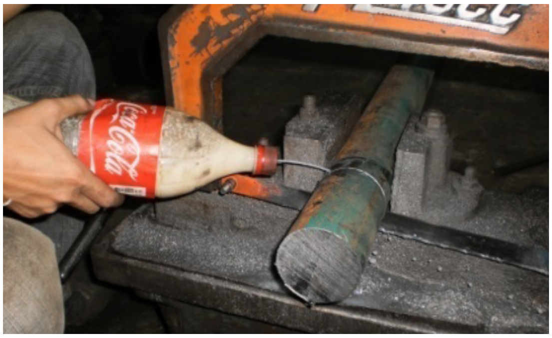
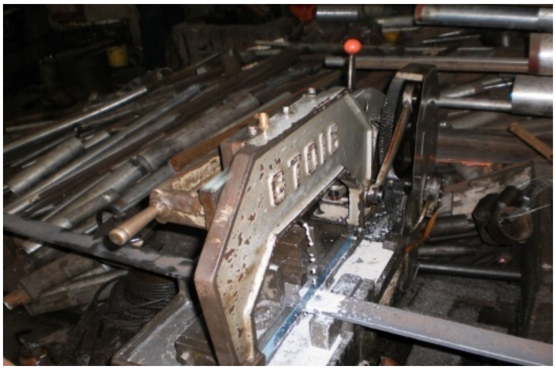


Figure 10. Cutting thin cross section of steels from a hydraulic oil dispenser.



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