III – Results & Discussion

III -1 -Results For Analysis Of Imported Semi Synthetic Cutting Oils

Table (15): Results for Imported OIL NO. 1

Tests	Results	Specification
Physical Appearance	Clear Liquid	Clear Liquid
Color	Yellow	Yellow
Thermal Stability IP311	No separation	No turbidity or separation
Emulsion Stability IP263	Oil: Nil Separated materials: Nil	Oil: Nil Separated materials: Nil
Frothing IP312	10 , 0 , 0 , 0	Report
Corrosion IP125	0 - 0 – 0	0 -0 -0
Four ball Welding load , Kg	120	High as possible
PH of 1% in D/W	8	6 – 9

Table (16): Results for Imported OIL NO. 2

Tests	Results	Specification
Physical Appearance	Clear Liquid	Clear Liquid
Color	(Clear Blue)	Clear Liquid
Thermal Stability IP311	No separation	No turbidity or separation
Emulsion Stability IP263	Oil: Nil Separated materials: Nil	Oil: Nil Separated materials: Nil
Frothing IP312	10 , 0 , 0 , 0	Report
Corrosion IP125	1 -0 - 0	0 -0 -0
Four ball	125	High as possible
PH of 1% in D/W	8.4	6- 9

III – 2 - Evaluation Of Imported Semi Synthetic cutting Oils

Results obtained from analysis of imported semi synthetic cutting oils are presented in tables (15) & (16), respectively.

The data showed that the imported oils is thin color transparent liquid, highly thermal and emulsion stability compounded by high efficiency antirust and smooth additive, nonionic surfactant, stabilization agent etc. Its diluents are transparent. It has excellent functions of cooling, lubricating, anti rust and anti corrosion etc. It can be cycle used in a long-term. It is innoxious, not corrosive, used for grinding and normal cutting for steel, cast iron etc. Especially used for a mass of cutting, fast cutting, and required to offer the cooling speed processing ways.

Important Characteristics:

1. It has excellent antirust property to ensure the anti rust of work pieces and instruments.
2. Excellent cooling function, can remove a lot of grinding heat in time while grinding, and can extend the using period of grinding wheels.
3. No smells, easy to be accepted by operators. The anti corrosion property is very good with a long term using period.
4. Prepare it to be 3~5% consistence by tap water, it can be used it circularly. The addition is termly.

III - 3 - Formulation and Evaluation Of semi synthetic cutting oils

Semi synthetic cutting oil contains primary emulsifier as petroleum sulphonate, non-ionic surfactant, oleic acid, amine and coupling agent [81]. The physical and chemical properties of non-ionic surfactant, oleic acid, amine and coupling agent which were incorporated with SNS to formulate the cutting oil are listed in Tables (8), (10), (12), (13) & (14) respectively.

Twenty blends containing different ratios of emulsifier package components with paraffinic base mineral oil (30 cSt at 40 0C) were blended as mentioned before (Experimental part) to select the best blend having the maximum stability for both blend and emulsion.

From Table (17), it is evident that only four blends are favorable for both blend stability and emulsion stability according to IP 311 and IP 263 standard test methods respectively. The successful four blends have numbers (17), (18), (19) and (20) without anti-wear/anti-corrosion additives.

The obtained results as listed in Table (17) indicates the following:

- Blends numbers (3,4,8,10,15and16) failed so, they gave milky white emulsions when diluted with water. Accordingly the other evaluated tests did not carried out on them.

- The blends numbers(17,18,19&20) gave translucent emulsions and very good in thermal and emulsion stability but,the optemimum formulation is blend number(17) ,so it has Translucent appearance ,very good anti corrosion / anti-wear properties as we saw after and low percent of emulsifier agents .

Table (17)
Semi synthetic cutting oil
Blend Trial

Sample NO. / Blending%	1	2	3	4	5	6	7	8	9	10
Base oil	85	80	75	75	70	65	60	60	55	55
SNS	6	7.5	10	10	12	13	14	15	17	17.5
Non-Ionic surfactant	3	5	5	4.5	6	9.2	12.6	10.9	14.3	12.1
Fatty acid	4	5.5	8	8.5	9	9.5	10	10.5	11	11.5
Alkanol amine	0.8	0.8	0.8	1	1.5	1.7	1.7	1.8	1.8	1.9
Coupling agent	1.2	1.2	1.2	1	1.5	1.6	1.7	1.8	1.9	2
Blend stability IP 311	Fail	Pass	Pass	Pass	Pass	Fail	Fail	Pass	Fail	Pass
Emulsion stability	-----	Fail	Pass	Pass	Fail	-----	-----	Pass	-----	Pass
Appearance	-----	-----	*MWE	MWE	-----	-----	-----	MWE	-----	MWE

*M. W.E = Milky White Emulsion.

Table (17) Continued.

Sample NO. / Blending%	11	12	13	14	15	16	17	18	19	20
Base oil	50	50	50	50	50	47	45	40	35	30
SNS	18	17.5	17.5	18	20	20	21	22	23	24
Non-Ionic surfactant	9.4	10.5	10.7	10	9	12	12	15	16	18
Fatty acid	17.5	17.3	17.1	13.7	16.5	16.5	17	17.5	20.5	22.5
Alkanol amine	2.6	2	2	5.8	2.2	2.2	2.5	2.5	2.5	2.5
Coupling agent	2.5	2.7	2.7	2.5	2.3	2.3	2.5	3	3	3
Blend stability	Fail	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass	Pass
Emulsion stability	-----	Fail	Fail	-----	Pass	Pass	Pass	Pass	Pass	Pass
Appearance	-----	-----	-----	-----	MWE	MWE	*T.E	T.E	T.E	T.E

*T.E = Translucent Emulsion.

III - 4 -Miscellaneous Cutting Oil Additives

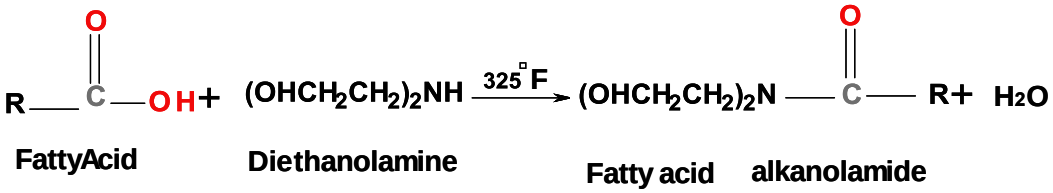
Two types of anti-wear/anti-corrosion additives were synthesized during this study. These are: Abietic diethanol Amide and Oleic di ethanol Amide they were synthesized using Abietic and Oleic acids as described in experimental part.

Table (9) and (10) includes the physico-chemical properties of the used acids Abietic and Oleic respectively. While **Table (18)** includes the optimum condensation reaction conditions applied during the synthesis of the two carboxylic amides.

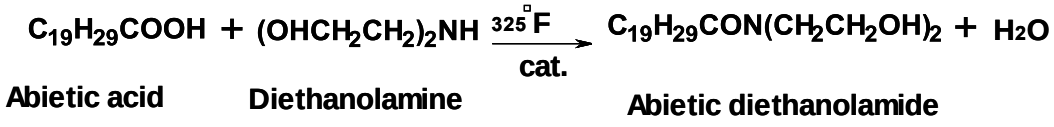
Table (18): The Optimum Conditions of Condensation of Di-Ethanol Amine with Abietic Acid & Oleic Acid

Condition	Abietic Acid	Oleic Acid
Temp ^{o}C	175	180
Reaction time / hr	3	5
Stirring rate/rpm	150	100
pressure	atmospheric pressure	atmospheric pressure

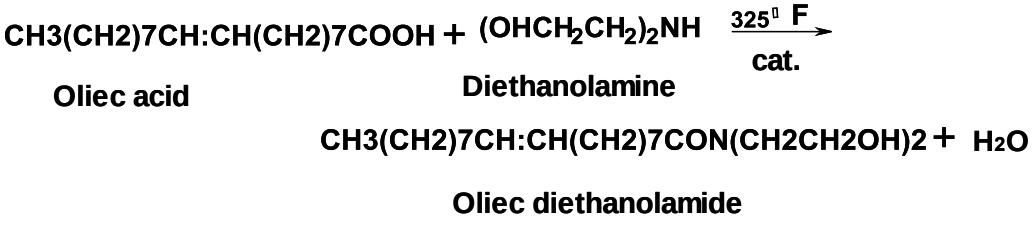
The following chemical equations show the chemical structure of the synthesized amides.



EQUATION - 1



EQUATION - 2



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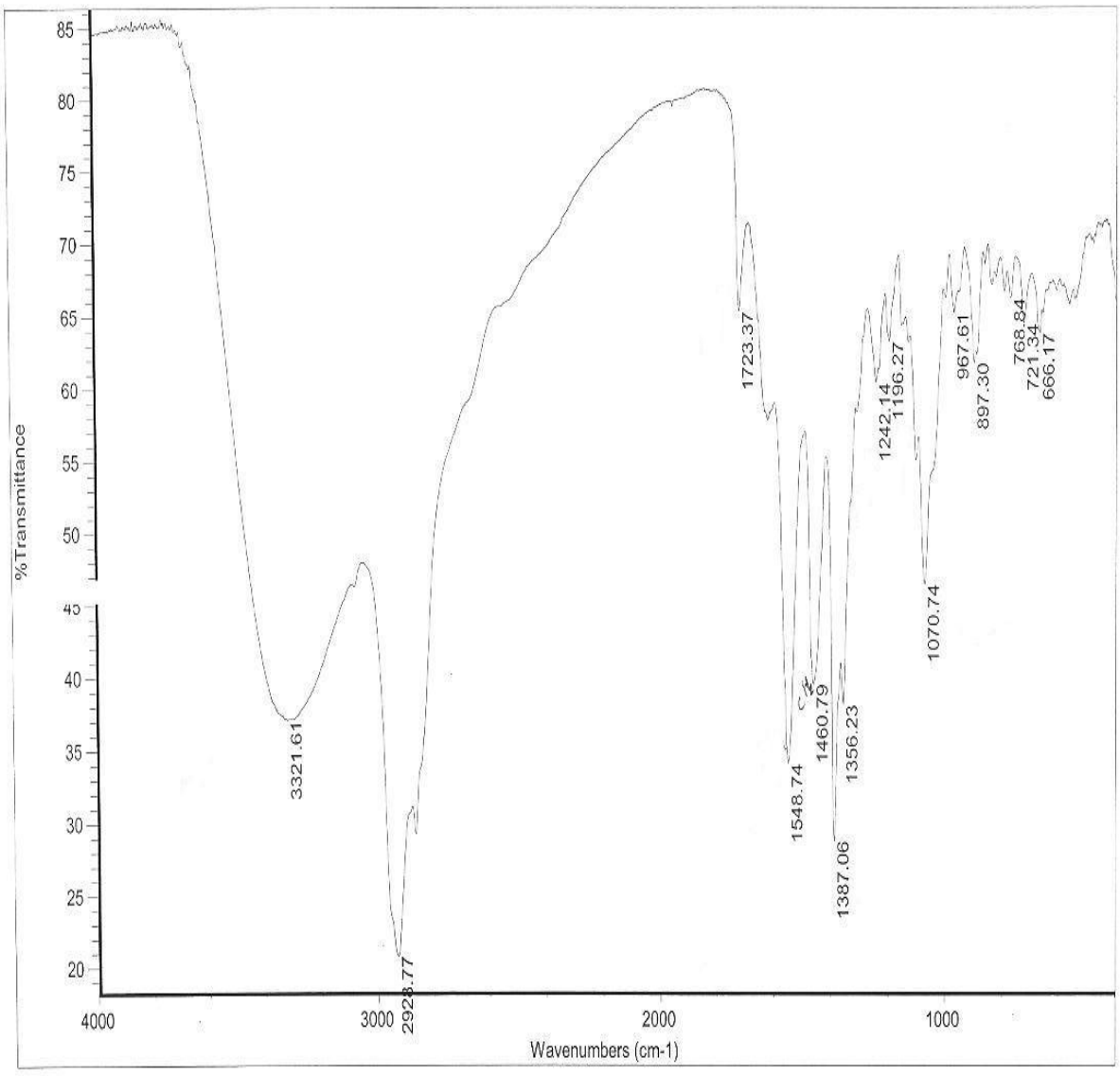
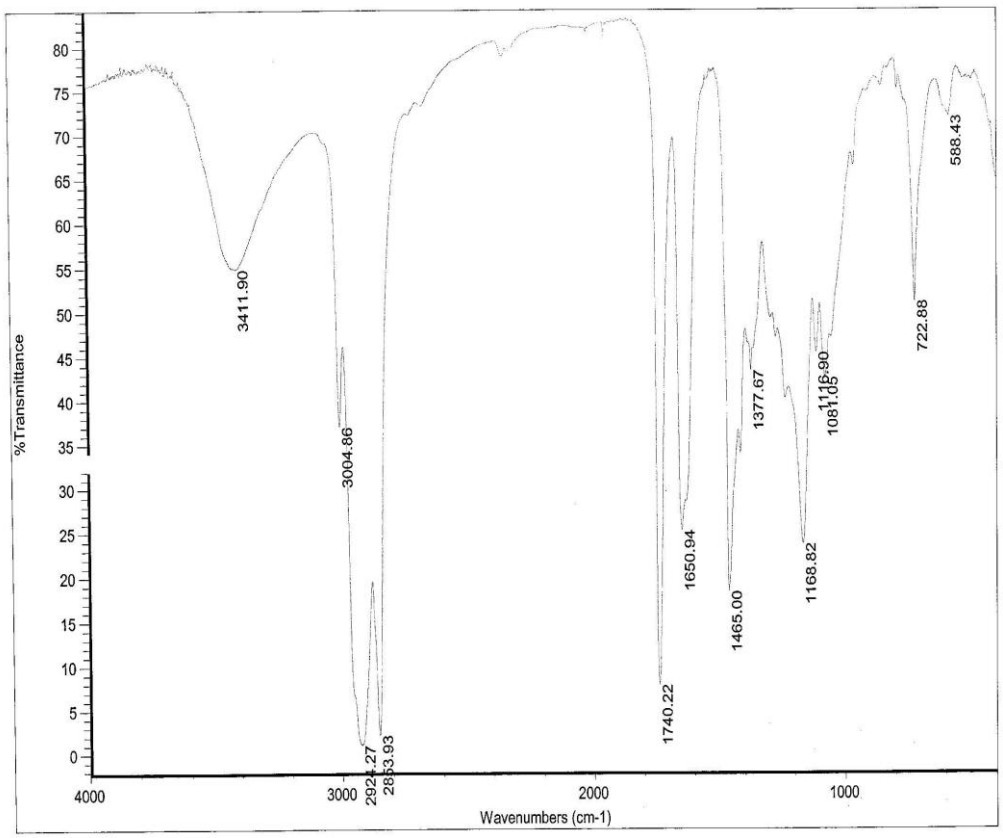

%Transmittance
85
80
75
70
65
60
55
50
45
40
35
30
25
20
4000
3000
2000
1000
Wavenumbers (cm-1)
3321.61
2928.77
1723.37
1548.74
1460.79
1387.06
1356.23
1242.14
1196.27
1070.74
967.61
897.30
768.84
721.34
666.17


%Transmittance
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
3411.90
3004.86
2924.27
2853.93
1740.22
1650.94
1465.00
1377.67
1168.82
1116.90
1081.05
722.88
588.43
4000
3000
2000
1000
Wavenumbers (cm-1)

IR Spectral Data for Abietic diethanolamide

Table (19): Wave Number for Abietic diethanolamide

Wave Number , cm^{-1}	Characteristic Group
3321	—OH
2928	CH_2 Asymmetric
1723	C═O
1629	Amide group
1548	C— N
1387	CH_3 group

IR Spectral Data for Oleic diethanolamide

Table (20): Wave Number for Oleic diethanolamide

Wave Number , cm^{-1}	Characteristic Group
3411	—OH
2924	CH_2 Asymmetric
2853	CH_2 symmetric
1740	C=O
1650	Amide group
1465	CH_2 Group
1377	CH_3 group
1168	C—O

Characterization of the additives:

The chemical structures were confirmed via IR analysis as shown in Figures (17) & (18) for synthesized Abietic diethanolamide and oleic diethanolamide respectively and listed in Tables (22&23).

From figures (17) & (18) spectral data observed are:

- Band at 3321 cm^{-1} & 3411 cm^{-1} characteristic for —OH group.

- Band at 2928 cm^{-1} & 2924 cm^{-1} characteristic for CH_2 Asymmetric.

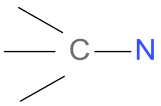
- Band at 1723 cm^{-1} & 1740 cm^{-1} characteristic for C = O Of ester amide.

- Band at 1387 cm^{-1} & 1377 cm^{-1} characteristic for CH_3 group.

These bands were observed for the two synthesized amides.

—OH group for the unreacted materials and / or alkanolamine.

It was observed also in figure (17) aband at 1548 cm^{-1} characteristic for



of amide.

- In fig (17) there is a band at 1650 cm-1 characteristic for amide group.

Oleic diethanol amide is the most intense absorption band. It is primilary governed by the stretching vibrations of the C=O (70-85%) and C-N groups (10-20%). Its frequency is found in the range between 1600 and 1700 cm^{-1}. The exact band position is determined by the backbone conformation and the hydrogen bonding pattern.

Abietic diethanol amide is found in the 1548 and 1629 cm^{-1} region and it is more complex than oleic diethanolamide. The rest of the potential energy arises from the C-N (18-40%) and the C-C (about10%) stretching vibrations.

III-5-Evaluation of Additives Application:

Semi synthetic cutting fluids is water based chemical fluids .Table (21) represents the anti corrosion effect of the synthesized additives with the semi synthetic cutting fluids. From the table, we concluded that the 2 % ratio for the abietic diethanolamide & 4%for oleic diethanolamide give excellent anti-corrosion character.

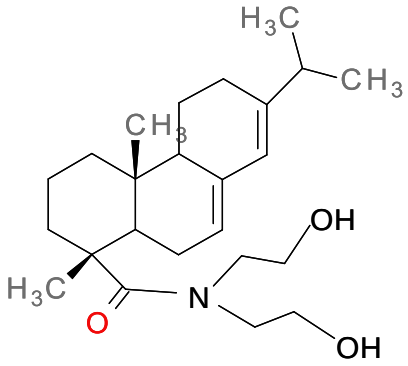
Table (21):
Properties of Synthesized Anti-Corrosion / Antiwear Additive

Additive % / **Test**	**Abietic diethanolamide**	**Oleic diethanolamide**
	2 %	**4 %**
Cast Iron Corrosion Test , IP 125 Max.value for standard test. Obtained value for synthesized amide.	0 / 2 0 / 0	0 / 2 0 / 0
Four -Ball Test , IP 239 Scar Diameter, mm (anti – wear function)	0.96	0.99
Welding load , Kg Extreme pressure function	127	122

PROPERTISE OF ABIETIC DIETHANOLAMIDE

Water – miscible and oil soluble corrosion inhibitor

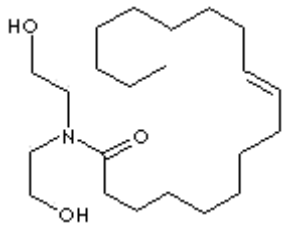
Table (22)

Chemical structure And Formula	$C_{19}H_{29}CON(CH_2CH_2OH)_2$ 
Molecular Weight	**389**
Appearance	**Brown oily viscous**
Solubility	**Turbidly soluble in water** **Clearly soluble in mineral oils**
Solubility to water hardness constituents	**Good**
Application	**Improves the corrosion inhibiting properties of metal working fluids. It is used primarily for the preparation of water soluble coolants based on mineral oil .By varying the concentration of Abietic diethanol amide it is possible to adjust the corrosion inhibiting effect of the emulsion to the especial requirements .**

PROPERTISE OF OLEIC DIETHANOLAMIDE

Water – miscible and oil soluble corrosion inhibitor

Table (23)

FORMULA	**$CH_3(CH_2)_7CH=CH(CH_2)_7C(=O)N(CH_2CH_2OH)_2$** 
MOL WT.	**369.59**
PHYSICAL STATE	**clear liquid**
SOLUBILITY IN WATER	**soluble (oil soluble)**
STABILITY	**Stable under ordinary conditions**
APPLICATIONS	**Improves the corrosion inhibiting properties of metal working fluids. It is used primarily for the preparation of water soluble coolants based on mineral oil .By varying the concentration of Oleic diethanol amide it is possible to adjust the corrosion inhibiting effect of the emulsion to the especial requirements.**

Results of Field Trials

The field trials of the prepared water-soluble semi synthetic cutting oils were carried out at **EL– ARABBEYA FOR INTEGREATED INDUSTRIES CO. (S .A. E) – Third Industrial Zone – Badr City – EGYPT. (ARINCO ISO9001: 2000).**

These trials were carried out on the two prepared semi synthetic cutting oils based on sodium naphtha sulphonate (**SNS**) as primary emulsifiers and the other emulsifier package as raw materials in addition to the synthesized Abietic Diethanol Amide & Oleic Diethanol Amide anti-wear / anti-corrosion additive (labeled **SAMPLE 1** and **SAMPLE 2**). These two tested cutting oils were compared with commercial cutting oil based on imported emulsifier package.

From **EL– ARABBEYA FOR INTEGREATED INDUSTRIES CO. (S .A. E) – Third Industrial Zone – Badr City –EGYPT. (ARINCO ISO9001: 2000).**

field trial report (**cf.** the attached sheets), it is clear that the prepared water-soluble semi synthetic cutting oils are successed in the field trials and can be used for **fifteen days** in case of SAMPLE **2**)., and for **seventeen days** in case of **SAMPLE 1**; while the period use of the commercial cutting oil, based on imported emulsifier package, does not exceed two week. This means that **SAMPLE 1** and **SAMPLE 2**) is valuable and good for several uses as semi synthetic cutting oils.

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الشركة العربية للصناعات المتكاملة
(ش.م.م)

٢٢٩٥
٢٠١٠/١/١٤

تجارب حقلية على زيوت القطع شبه التخليقية

والمرسلة من مركز بحوث شركة مصر للبترول /غمرة

بناء على طلب مركز بحوث شركة مصر للبترول بغمرة بأجراء تجارب حقلية على عدد من عينات زيوت القطع شبه التخليقية , حيث قام :-

السيد الكيميائى / ناجى سليمان صقر بإدارة البحوث التحليلية

بموافاتنا بالعينات التالية :

1-زيت قطاع شبه تخليفى عينة 1

2- زيت قطاع شبه تخليفى عينة 2

وبناء على توصياتهم الفنية الخاصة بأجراء تجارب حقلية على ماكينات تمثل عمليات القطع المختلفة

1- عمليات التجليخ

2- عمليات تفريز

3- عمليات خراطة

4- عمليات ثقب

5- عمليات قلوظة

وعليه تم تحميل هذه العينات على ماكينات تمثل هذه العمليات كالأتى :

العينة	الماكينة محل التجربة	تاريخ بداية التشغيل	تاريخ التغير
مستحلب العينة 1	ماكينة خراطة ,منشار ترددى,ماكينة تجليخ سطحى ,ماكينة قلاووظ,مثقاب	2009/12/5	2009/12/20
مستحلب العينة 2	ماكينة خراطة ,منشار ترددى,ماكينة تجليخ سطحى ,ماكينة قلاووظ,مثقاب	2009/12/21	2009/1/5

Factroy : Block 9B-Third Industrial Zone-Badr City-EGYPT.
Tel.: (202) 28640215 Telefax.: (202) 28640236
E-mail: info@arabbeya.com Web Site : www.arabbeya.com

المصنع : بلوك ٩ ب المنطقه الصناعية الثالثة - مدينة بدر.
تليفون : ٢٨٦٤٠٢١٥ (٢٠٢) تليفاكس : ٢٨٦٤٠٢٣٦ (٢٠٢)

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• الشركة العربية للصناعات المتكاملة
(ش.م.م)

٢٠١٠/١/١٤ ٢٩٥

* نتائج تقييم زيوت القطع المستحلبة (مقابل الزيوت المستوردة)

عنصر التقييم	التقييم	
	العينة 1	العينة 2
سرعة الاستحلاب مع المياه	جيد	جيد
ثبات المستحلب	جيد	جيد
كفاءة التبريد والتزييت	جيد	جيد
تغيير لون الزيت	بعد 17 يوم	بعد 15 يوم
ظهور روائح كريهة	بعد 17 يوم	بعد 15 يوم
مقاومات الصدأ للمشغولات والماكينات	جيد	جيد
نعومة الاسطح المشغلة	جيد	جيد
تأكل الحد القاطع (عدد مرات سن الحد القاطع)	جيد	جيد
تأثير المستحلب على جلد العامل	تأثير خفيف	
فترة التشغيل	17 يوم	15 يوم
سبب التغيير	تغيير اللون وظهور روائح كريهة	

ملحوظة:- علما أن الزيت المستورد يتم أستخدامه لفترة لا تتعدى اسبوعين .

مدير المصنع

أ/ فوزى عيد

١٤/١/١٠

مدير الانتاج

Mr/ Ustun Omur

الشركة العربية للصناعات المتكاملة
ش.م.م
ت: ٨٦٤٠٢١٥ - ٨٦٤٠٢٣٦ / ٠٢

Factroy : Block 9B-Third Industrial Zone-Badr City-EGYPT.
Tel.: (202) 28640215 Telefax.: (202) 28640236
E-mail: info@arabbeya.com Web Site : www.arabbeya.com

المصنع : بلوك ٩ ب المنطقـه الصناعيـة الثالثـة - مدينـة بـدر.
تلبفون : ٢٨٦٤٠٢١٥ (٢٠٢) تليفاكس : ٢٨٦٤٠٢٣٦ (٢٠٢)

Feasibility Study

Objective study for economic value of our product Aims to provide a product with low price for its imported Counterpart at the same quality.

The cost per ton of imported semi synthetic cutting oil is equal to 30,000 LE while the cost of our product is equal 18,000 LE at the same dose. Saving a lot of money (40%) These prove that the local product for the local market than foreign imported product.