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Extended Abstract

Lubricants and Their Impact on the Environment

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Abstract:

Concerned with preserving the quality of the environment, there is the need to develop more and more efficient lubricants, which respond to the technological evolutions of the uses and with spaces (time of use or distance traveled) of longer and longer.

In this research, we use many resources to visualize and problematize the Optimization and Recycling of Lubricants in the world and it impact of environment.

Introduction:

Concerned with preserving the quality of the environment, there is the need to develop more and more efficient lubricants, which respond to the technological evolutions of the uses and with spaces (time of use or distance traveled) of longer and longer.

As such, it is necessary to:

Introduce new quality of lubricants such as semi-synthetic, synthetic and biosynthetic for engines to meet the new requirements of car manufacturers.

Substitute the 2T lubricants (oils mixed with the fuel and burned in the engine) by other non-polluting product.

Proposal to improve the lubrication of equipment's with a specific and recyclable gas.

Optimize the use of lubricants by introducing an online indicator that informs us of the time to change it (do not refer only to the distance traveled and the visual aspect).

The recycling of lubricants, the reuse of these if necessary after regeneration (this operation is limited by the degree of contamination).

In this research, we use many resources to visualize and problematize the Optimization and Recycling of Lubricants in the world and it impact of environment; all information that we need for this research we can resume in graphs, curves, tables and pictures.

Lubricants

Lubricants is the procedure to diminish wear of one or the two surfaces in nearness, and moving comparative with one another, by intervening a substance considered lubricant between the surfaces to help convey the heap between them.

Types of Lubricants:

1. **Solid Lubricants**: Solid phase often placed in between bearing surfaces undergo more shear than bearing materials it self-performance majorly relies on the applied load; she Must be able to support applied load without significant distortion.

The Coefficient of friction and the rate of wear must be acceptably low to increase durability, resins are bonded to solid lubricants increase wear life, surface film thickness etc.

They are termed bonded coatings mainly used in: (a) Cylindrical bushes (b) Separator (c) Electrical brushes

Like the Poly Tetra Fluoro Ethylene (PTFE) polymer also called as Teflon be Graphite and the Disulfure de Molybdène.

2. **Liquid Lubricants**: also known as liquid oils low viscosity oils have low fluid friction losses (Hence low hear generation) liquid can carry away heat, high Boiling point , low freezing point , high resistance to oxidation and heat and non-corrosive properties.

Classification:

a) Mineral Oil

Mineral Oils are made up of Hydrocarbons; basically these are complex molecules of Hydrogen and Carbon such as Paraffin's, Naphthenes and Aromatics, which are distilled from Crude Oil,

They also contain additives to modify performance and to prevent them from degrading.

Mineral oils are generally cheap to purchase, the manufacturing process is not environmentally friendly and they tend to degrade more rapidly than other types of oils.

As with all oils, they come in a range of different viscosities such as light, medium and heavy oils.

Mineral oils are suitable for lubricating plain journal bearings, gears, and slide- ways on machines or for pumps and compressors where the operating temperature is reasonably low.

b) Vegetable Oils

Soluble Vegetable oils are used extensively on machine tools as coolant and cutting tool lubrication.

Their purpose is to keep the tool and work-piece cool, aid the cutting process/improve surface finish, wash away swarf/material particles and prolong the life of the tool.

Two common vegetable oils used are extracted from sunflower seeds and Rapeseeds.

The oils are soluble in water and form a milky liquid when mixed with water.

Vegetable oils are biodegradable so better for the environment.

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c) Synthetic Oils

Fully Synthetic oils are completely man made from silicones, polymers, esters and other additive which enhance the performance over wide operating temperatures and gives more effective resistance.

These oils are more expensive and are considered more environmentally friendly than basic Mineral oil.

This type of oil is usually used for high performance internal combustion engines where temperature change covers a larger range and also protects the parts better from cold starts and at lower temperatures.

d) Bio Synthetic Oils

Biosynthetic Technologies utilizes a chemical reaction process to convert fatty acid into a new molecule structure called an estolide.

One of the key benefits to these biosynthetic oils is their ability to keep engine surfaces cleaner and reduce wear on bearing surfaces as compared to petroleum-based oils.

The 5W-30 motor oil recently certified by the API achieved a piston deposit cleanliness rating of 8.5 out of 10. Petroleum synthetic oils typically score between 6.0 and 7.0, while conventional petroleum oils score between 4.0 and 5.5.

API certification marks an important step in the commercialization process and paves the way for use by motor oil manufacturers.

These biosynthetic motor oil formulations also meet the 25-percent bio-based content requirement needed for certification under the U.S. Department of Agriculture's BioPreferred program.

Working with Infineum, the additive subsidiary of ExxonMobil and Shell, Biosynthetic.

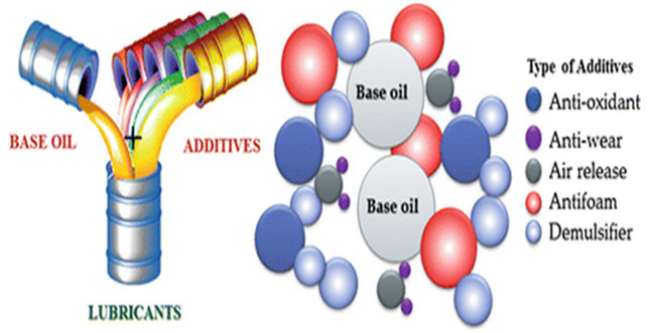

Figure 1: The Lubricants composition.

3. Gaseous Lubricants:

Gas (Air, Nitrogen, and Helium) lubrication is used for ultra-thin film thickness (separation) between tribo-pairs.

The advantages was Temperature range– (-2000 C) to (20000 C)

Possible high speed, Cleanliness and No seal requirement for lubrication.

His disadvantages was Low load capacity, Low damping, needs specialist designer and manufacturer.

4. SEMI-SOLID LUBRICANTS (Grease):

Grease is the most widely recognized semi-strong oil; it is a blend of oil and thickening specialists, for example, mineral oil and cleanser.

when applied they remain in place and are resistant to being displaced by centrifugal force, they form a seal against water and other contaminants from entering the components of the system, reduce oil vapor problems, Prolong the life of worn parts and Reduce noise and vibration.

Disadvantages are they do not dissipate heat as well as oils, also because of the high viscosity they create a certain resistance to motion.

5. Nanoparticules

Many companies and research laboratories are currently working on improving lubricants by incorporating nanoparticles, the dimensions of which are around a few billionths of a meter.

The US Company StClaire announces the marketing, after twenty years of research, of products called "Nano Bearings®". These are spherical molecules with diameters close to

90 nm and which exhibit anti-friction qualities, particularly in the case of very high contact pressures.

Nano-Bearings adhere strongly to surfaces, from which they penetrate the hollows of roughness, ensuring an effective barrier against oxidation and humidity. They are not flammable and can be incorporated into a wide range of synthetic or mineral based lubricants, whether oils or greases. According to the manufacturer, they do not contain PTFE, graphite, molybdenum disulphide, copper, lead, silicones or dangerous solvents. The reader will find more information on the manufacturer's website.

Significant research is currently taking place on the addition of boric acid nanoparticles, in particular in oils intended for heat engines. It seems that very appreciable gains can be obtained on the coefficient of friction.

Materials and Methods:

In this research, we use many resources such as books ,sites,intern et,publications,theses, research's,...which we can collect various relevant information, since these help to visualize and problematize the Optimization and Recycling of Lubricants in the world; all information that we need for this research we can resume in graphs ,curves, tables and pictures.

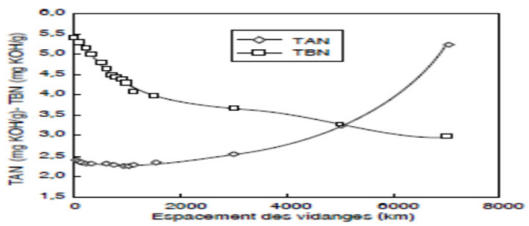

Figure 2
Variation du TAN et du TBN en fonction de l'espacement des vidanges.
Variation of the TAN and TBN as a function of the distance between the oil changes.

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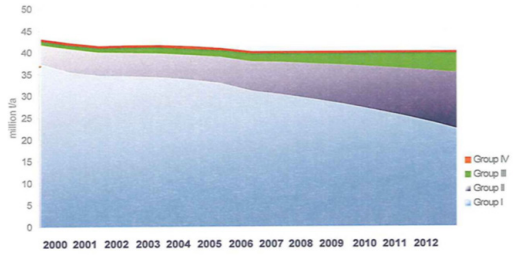

Figure 3: Changes in lubricant requirements translate into changes in base oil requirements

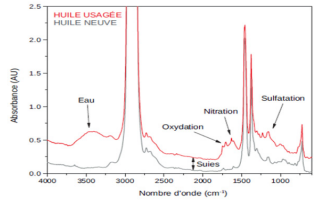

Figure 4: The measurements with IR technique

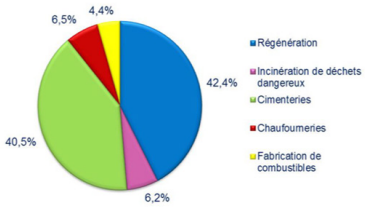

Figure 5: Distribution of approved (used) capacity for processing black used oil in France

Évolution des caractéristiques physico-chimiques des huiles en service avec l'espacement des vidanges

Evolution of the physicochemical characteristics of the oils in use with the distances between oil changes

Espacement des vidanges (km)	Densité D_4^{20}	Viscosité à 40°C (mm^2/s)	Viscosité à 100°C (mm^2/s)	Indice de viscosité (IV)	Point d'aniline (°C)	Point éclair (VO) (°C)	TAN (mg KOH /g)	TBN (mg KOH /g)	Dilution (% V)	Teneur en eau (% V)	Carbone Conradson (% p)	Point d'écoulement (°C)	Couleur (% T)	Indice de réfraction
0	0,8793	153,84	17,04	120	110	244	2,40	5,40	0,00	0,00	0,00	−22	99	1,485
50	0,8803	151,84	16,90	120	109	-	2,37	-	0,00	0,00	0,62	−23	98	-
106	0,8810	149,24	16,70	120	108	-	2,35	5,30	0,05	0,010	0,69	−23	95	1,485
158	0,8814	141,20	16,10	120	106	243	-	-	0,10	-	0,70	-	90	-
210	0,8825	139,00	15,95	120	104	242	2,33	5,15	-	0,012	0,75	−22	84	1,484
310	0,8845	133,20	15,50	121	103	241	2,32	5,00	0,34	-	-	-	-	-
410	0,8858	128,00	15,10	121	102	-	-	-	0,41	-	0,87	−22	75	-
502	0,8863	125,50	14,90	121	101	240	-	4,80	0,50	0,015	0,95	−21	53	1,483
600	0,8874	123,00	14,70	121	100	-	2,31	4,65	-	-	0,99	−23	50	-
702	0,8880	120,65	14,50	121	99	239	2,29	4,50	0,70	0,017	-	−22	-	1,483
800	0,8890	118,30	14,30	122	98	-	-	4,45	0,84	-	1,20	-	40	1,483
900	0,8898	113,50	13,90	122	97	238	2,27	4,40	0,92	-	-	-	30	-
1000	0,8901	92,25	12,00	122	96	236	2,25	4,29	2,20	0,20	1,472	−21	20	1,482
1100	0,8926	87,00	11,50	122	-	-	2,30	4,10	-	-	-	-	17	-
1500	0,8942	84,65	11,30	122	95	228	2,34	3,98	2,30	0,24	1,520	−20	14	1,483
3000	0,8951	80,24	11,00	125	94	226	2,55	3,69	2,50	0,30	1,900	−21	10	1,484
5000	0,8963	133,50	16,70	135	93	218	3,25	3,29	3,70	0,56	3,700	−22	9	1,485
7000	0,8982	153,50	20,16	152	91	213	5,25	2,98	4,28	3,00	4,300	−22	7	1,486
Normes ASTM	D1298	D445	D445	D2270	D611	D92	D664	D2896	D3828	D1744	D189	D97	D155	-

TAB 1: Evolution of the physicochemical characteristics of the oils in use with the distances between oil changes.

Results and Discussion:

1. Synthetic lubricants are made from esters, silicones, polymers and other additive which enhance the performance, they are considered to be more environmentally friendly.

Mineral lubricants are distilled from Crude Oil; they also contain additives to modify performance and to prevent them from degrading, the manufacturing process is not environmentally friendly, they tend to degrade more rapidly and those VI is lower than Synthetic lubricants(so she need more additives to correct it).

it is now possible to space Synthetic lubricants changes by 20,000 or 30,000 Km and up to 50,000 Km for a diesel engine or instead of 5,000 Km whith mineral lubricants , therefore less consumption and less pollution.

2. Towards dry lubrication to replace lubricants for 2T engines:

Lubrication with a solid coating has advantages over traditional lubrication, so no addition of lubricants in the carburant therefore no burnt lubricants or smoke released.

The three most commonly used solid lubricants are graphite, molybdenum disulfide and polytetrafluoroethylene (PTFE) also called Teflon, high chemical stability, not toxic and very low wear rate.

The methods of applying the solid lubricants are applied by spraying them on the surface using an aerosol can or adding them to the molten metal during the process manufacturing

3. Gas lubrication has many advantages over lubricants and greases.

Typical gases used are air, inert gases and carbon dioxide

The gas can be used under low pressure, it then behaves like an almost incompressible fluid, and displacements are then obtained on "air cushions".

In other applications, the gas is subjected to much greater pressures, such as that of aerostatic guides which make it possible to obtain very high speeds without any material contact.

A major drawback of gas lubrication is that it requires a constant supply of gas, which is expensive due to the use of compressors.

The parts also need to be machined with greater precision to meet tighter tolerances.

Typical operating pressures range from 2 bar to 30 bar.

Components are usually sprayed with solid lubrication during assembly to protect them in the event of a compressed gas supply failure.

4. An indicator was proposed which is based on infrared spectroscopy (ASTM E2412) to define the degree of contamination of the oil; and for more precision we can supply the various emptying stations by portable analyzers with free tests.

5. For The black lubricants mainly from automotive lubrication he molecules are badly damaged by undergone severe thermal and mechanical, the regeneration operation purify the lubricants of the main constituents such as gasoline, fuel and water tars, antifreeze and metallic soap, atmospheric dusts, chips (metal scrap) and metal oxides such as lead oxide and combustion residues, but we haven't solution to remedy the damage molecular, and also don't forget the costs for this operation, this viability remains complex even under conditions favorable.

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Conclusion:

The Synthetic lubricants are the solution, more environmentally friendly, less consumption and less pollution.

Lubrication with a solid coating has many advantages over traditional lubrication, save money and keep environment.

It is recommended to use Gas lubrication it in large equipment because it requires a constant replenishment of gas, hence the need to use compressors.

The proposed indicator define the degree of contamination of the lubricants ,the results allow users to replace it as necessary; so we push it to the maximum in case of deterioration in quality we can improve its viscosity and continue its use.

We do not recommend the reuse of black lubricants ,because the molecules are badly damaged ,it is preferable to use it as fuel after being regenerated and to get rid of its heavy metals which will be reuse consequently in the manufacture of additives.

References

Articles:

1. Eric Lecointre. Collecte et traitement des huiles usagées bilan de l'année 2012, Décembre 2013, ADEME Angers.

2. Sheng Shen. Molecular Gas Film Lubrication,2016.

3. Chevron. Suivi et Contrôle des Huiles Industrielles en Service, Séminaire Lubrifiants 2007.

4. Chevron. Revue du marché mondial lubrifiants, Séminaire Lubrifiants 2007.

5. Nader Ben Salem, Lubrification et Graissage, May 08,2014

6. Emilie Cornet. Vers une lubrification sèche pour le patrimoine horloger », EGG 4 | 2014.

7. Ris Justina Skinner.Types de lubrifiants liquides (huiles minérales, huiles synthétiques et huiles végétales) Semi-solides (graisses) solides (graphite, disulfure de molybdène, polytétrafluoroéthylène),2019.

8.Nishanth N ,Nikhil PS ,Harikrishnan K, Krishnadev U, Abdul Basith PA. Types of Lubricants, April 21, 2016.

9. Birmingham B.W, Sixsmith H, Wilson W.A. The Application of Gas-Lubricated Bearings to a Miniature Helium Expansion Turbine, Advances in Cryogenic Engineering, vol 7. Springer, Boston, MA (1962).

10. Drew Devitt. Lubrification à gaz dans les turbomachines, 27 mars 2019.

11. Joy McBride. Système de Lubrification,2016.

12. F. Mohellebi1, A. Bouchekhou1, N. Harbi1, R. Hadjoudj1 et C. E. Chitour1. Étude de la purification d'huiles usagées de type moteur au moyen d'une argile montmorillonitique,

Oil & Gas Science and Technology Ð Rev. IFP, Vol. 54 (1999).

13. L. I. Turchak and V. P. Shidlovskii.Mathematical Modeling of Gas Lubrication Problems,Dorodnicyn Computing Center, Russian Academy of Sciences;September 9, 2010.

14. David Philippon.Lubrification par la phase gazeuse : tribochimie des additifs phosphorés et boratés ,HAL Id 20 May 2008.

15. Centre d'Activités Régionales pour la Production Propre (CAR/PP). Possibilités de Recyclage et Utilisation Huiles Usées « Plan d'Action pour la Méditerranée »; novembre 2000.

16. FluidScan Handheld Oil

17. Noria news wires, Biosynthetic Soy-Based Motor Oils Receive API Certification

Sites internet :

1. www.biosynthetic.com.

2. https://www.fuelsandlubes.com

3. https://www.turbomachinerymag.com