

## STUDY OF TRIBOLOGICAL PROPERTIES OF ORGANIC COMPOUNDS OF VARIOUS LUBRICANTS IN CASTROL ALPHA SP 680 OIL

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### ABSTRACT

Castrol ALPHA Sp 680 transmission grease, based on highly refined mineral oil, is used to lubricate gears in mechanisms. The presence in its composition of various functional groups and elements provides the required performance properties of this oil. Castrol Alpha SP 680 gear oil, along with lubricating properties, has high antioxidant and anti-foam properties. The disadvantage of the oil is that it has low corrosion and extreme pressure properties. Therefore, the goal of our research was to develop a universal high-quality gear oil based on multifunctional and high-quality additives that meets modern requirements. The article presents an analysis of the IHP-14M additive in Castrol Alpha SP 680 gear oil and the results of comparative tribological tests with foreign additives with the same functional properties.

**Keywords:** transmission oils, tribological properties, additives, corrosion, lubricating effect.

### Introduction

It is known that the solution of the scope of lubricants for various purposes depends on the indicators of the physicochemical and operational properties of specific lubricants used in the machines and mechanisms used: oxidation, corrosion and extreme pressure, as well as tribological properties. Phosphorus, sulfur, nitrogen, carbonyl, carboxyl, etc. in the composition of active elements and organic compounds that provide various functional properties of oils. groups play a special role. The presence in the additives of high-quality structurally different organic compounds - dithiocarbonates, xanthates and trithiocarbonates of alkali metals, thionic and thiol sulfur - causes the creation of a continuous layer between rubbing metal parts [1-3].

Years of research have proven that in order for additives to have a high lubricating effect, they must contain elements such as sulfur, chlorine and phosphorus. Additives containing only phosphorus as an active element have a significant effect at moderate operating conditions, but a weak effect at high pressures. Sulfur-containing organic compounds form a group of universal additives that are effective against corrosion and abrasion in various operating modes [4-6].

At the Institute of Chemistry of Additives of the National Academy of Sciences of the Republic of Azerbaijan, a large research work has been carried out in this area, a number of

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additives against aging and scratches have been created. Targeted research conducted at the Institute of Chemistry of Additives over a long period of time made it possible to determine the optimal composition of sulfur additives with high lubricating properties, and as a result, a group of additives that are quite effective against corrosion and scratching - IHP-14A., additives IHP-14M, IHP-14M-MN (A.S. 525326 dated 04.11.74) were created.

In the Russian Federation, the production of the additive IHP-14M (S-metallyl-N, N-diethyldithiocarbamate) (A.c. 1761748A1, 09.08.90) was started, which is a new modification of the additive IHP-14A.

## Methods

The article presents an analysis of the IHP-14M additive in Castrol Alpha SP 680 gear oil and the results of comparative tribological tests with foreign additives with the same functional properties.

Castrol ALPHA Sp 680 transmission grease, based on highly refined mineral oil, is used to lubricate gears in mechanisms. The fact that Castrol Alpha SP 680 oil has a high viscosity-temperature property ensures its ability to start the engine at low temperatures. The presence of various functional groups and elements in its composition ensures the required performance properties of this oil. Castrol Alpha SP 680 gear oil, along with lubricating properties, has high antioxidant and anti-foam properties. The disadvantage of the oil is that it has low corrosion and extreme pressure properties. Therefore, the goal of our research was to develop a universal high-quality gear oil based on multifunctional and high-quality additives that meets modern requirements. To do this, oil compositions were created with a number of external additives taken at specified concentrations [7,8].

The tribological properties of oil and oil formulations of Castrol Alpha SP 680 have been tested in a 4-ball friction machine according to international standards ASTM D-2596, ASTM D-2266. The four-ball friction machine is a test setup consisting of three fixed (stationary) and one movable (movable) steel balls placed in a bowl.[9,10]

The anti-corrosion properties of the studied oil are evaluated by measuring the penetration load and corrosion centers during stripping. The performance varies with the applied load, so several tests are performed at different loads at the same time in order to correctly evaluate lubricant samples.

Anti-corrosion properties are often measured with an axial load of 1400N at room temperature and a rotational speed of the upper steel ball of 1420 rpm. The load continues up to a critical point until the complete destruction of the protective oil layer. Tribological properties are evaluated by the following indicators: welding load – PK, crisis load – PK, wear scar diameter - Dy, wear index SD.

Welding load (PC) is the definition of the smallest load that leads to wear of mechanisms and hardening of friction pairs [11-14].

Critical load (PK) - characterizes the maximum strength of the continuity of the lubricant layer on the metal surface without scoring. The diameter of the bite mark (Di) is determined under a powerful microscope at least 0.02 mm. Dimensions are measured at the end of machine operation or when the maximum friction force is reached.

Abrasion index (Iz) - determines the degree of erosion of metal surfaces from initial load to welding load. This characterizes the last limit of its performance. Determination of the degree of corrosion of metal surfaces, characterizing the maximum performance of the lubricant from the

initial load to the welding load.

The results obtained from studies carried out on a four-ball grinder provide fairly reliable values for friction points in accordance with the world standard DIN 5151 350/4.

## Results and discussion

The additives Lubrizol-10474, Petrolad-336 EP, DF-11 used in the research, taken in various concentrations, are highly effective extreme pressure additives [15-17]. The test results are shown in the table 1.

**Table 1.** Castrol Alpha SP 680 oil in 4-ball machine determination of tribological properties

COMPOSITIONS	Density additives, %	Tribological properties			
		D <sub>y</sub> - N	Pk- N	Pc- N	Si-mm
1. Lubrizol-10474+oils *	3	729	1568	4410	0,85
2. Additive Petrolad -339+*	3	614	1235	3528	0,80
3. Additive Petrolad-336 EP+*	3	613	1235	3479	0,62
4.Oil Castrol ALPHA Sp 680+*	–	622	1382	3097	0,76
5. IXP-14m + oil*	3	659	1568	3479	0,84
6. Lubrizol -10474+oil*	2	580	1568	3097	0,80
7. Lubrizol -10474+1,5%DF-11+*	3	–	–	–	0,72
8. Petrolad-336 EP +1,0%oil DF-11+*	3	–	–	–	0,82
9. Lubrizol-10474+0,75% oil DF-11+*	1,5	–	–	–	0,70

As can be seen from the table, a 3% additive Lubrizol-10474 gives a high result. Lubrizol's high-performance additives are used productively by many car manufacturers. They perfectly protect DIM (internal combustion engines) from corrosion, deformation, corrosion. Perfectly protects the metal elements of the power unit from friction during movement. Anti-corrosion additives are considered active ingredient chemicals for use in motor oils. They create a strong and reliable film on the surface of parts, and at the same time ensure their safety and long-term operation.

To ensure functional properties and characteristics against acid, moisture and salt, manufacturers used film-forming substances in anti-corrosion additives. In addition, Lubrizol has deposit suppression and removal properties and prevents tarnishing of metal engine components.

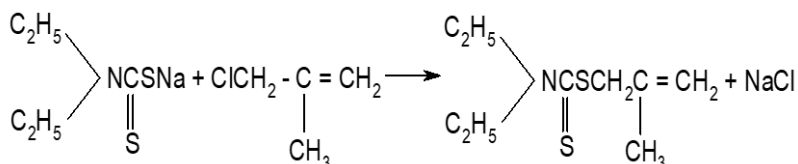
As for the overall density of additives, it may vary depending on the density of the protective coating. Thus, the composition of the additives provides protection for DYM metal elements from several weeks to a year, depending on the mileage and the frequency of oil changes. So, while Castrol ALPHA Sp 680 oil has a slip index of 622 N, a critical load of 1382 N and a welding load of 3097 N, with the addition of 3% Lubrizol 10474, the performance of this oil has a slip index of 729 N, and a critical load of 1568 N and a welding load 4410 N.

IHP-14M mentioned in the table The IHP-14m additive mentioned in the table is an invention belonging to the staff of the Institute of Chemistry of Additives of ANAS. Purposeful research conducted at the Institute of Chemistry of Additives over a long period of time made it possible to determine the optimal composition of sulfur additives with a high lubricating effect, and as a result, a group of additives that are quite effective against corrosion and peeling - IHP- Additives 14A, IHP-14M, IHP were created -14M-MN. The first of these additives, which came into

production and use, was the additive IHP-14A (S-allyl-N,N-diethyldithiocarbamate) (A.c. 525326, 04.11.74).

In 1990, the production of IXP-14M additive (S-metallyl-N,N-diethyldithiocarbamate) (A.c. 1761748A1 dated 08/09/90), a new modification of IXP-14A additive, was started in the Russian Federation[18].

Additives IHP-14M



In particular, it should be noted that modifications of the specified IHP-14 additive have been studied and used in gear oils.

## Conclusion

Thus, the development of external anti-scratch and anti-scratch additives in Castrol Alpha SP 680 oil not only increases its high carrying capacity, but also prevents destructive corrosion and squealing at the micro level and meets modern requirements..

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## ИЗУЧЕНИЕ ТРИБОЛОГИЧЕСКИХ СВОЙСТВ ОРГАНИЧЕСКИХ СОЕДИНЕНИЙ РАЗЛИЧНЫХ СМАЗОЧНЫХ МАТЕРИАЛОВ В МАСЛЕ CASTROL ALPHA SP 680

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### РЕЗЮМЕ

Трансмиссионная смазка Castrol ALPHA Sp 680 на основе минерального масла высокой очистки применяется для смазки шестерен в механизмах. Наличие в его составе различных функциональных групп и элементов обеспечивает необходимые эксплуатационные свойства этого масла. Трансмиссионное масло Castrol Alpha SP 680 наряду со смазывающими свойствами обладает высокими антиоксидантными и антипенными

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свойствами. Недостатком масла является то, что оно обладает низкими коррозионными и противозадирными свойствами. Поэтому целью наших исследований была разработка универсального высококачественного трансмиссионного масла на основе многофункциональных и качественных присадок, отвечающего современным требованиям. В статье представлен анализ присадки ИХП-14М в трансмиссионное масло Castrol Alpha SP 680 и результаты сравнительных трибологических испытаний с зарубежными присадками с такими же функциональными свойствами.

**Ключевые слова:** трансмиссионные масла, трибологические свойства, присадки, коррозия, смазывающее действие.

## YAĞLAYICI MATERIAL CASTROL ALPHA SP 680 YAĞINDA MÜXTƏLİF ÜZVİ BİRLƏŞMƏLƏRİN TRIBOLOJİ XÜSUSİYYƏTLƏRİNİN ÖYRƏNİLMƏSİ

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### XÜLASƏ

Yüksək təmizlənmiş mineral yağ əsasında Castrol ALPHA Sp 680 transmissiya yağı mexanizmlərdə dişli çarxların yağlanması üçün istifadə olunur. Tərkibində müxtəlif funksional qrupların və elementlərin olması bu yağın tələb olunan performans xüsusiyyətlərini təmin edir. Castrol Alpha SP 680 transmissiya yağı sürtgü xassələri ilə yanaşı, yüksək antioksidant və köpük əleyhinə xüsusiyyətlərə malikdir. Yağın dezavantajı onun aşağı korroziya və həddindən artıq təzyiqli xüsusiyyətlərinə malik olmasıdır. Buna görə də tədqiqatımızın məqsədi müasir tələblərə cavab verən çoxfunksiyalı və yüksək keyfiyyətli aşqarlar əsasında universal yüksək keyfiyyətli transmissiya yağı hazırlamaq idi. Məqalədə Castrol Alpha SP 680 transmissiya yağında olan İHP-14M aşqarının təhlili və eyni funksional xassələrə malik xarici aşqarlarla müqayisəli triboloji sınaqların nəticələri təqdim olunur.

**Açar sözlər:** transmissiya yağları, triboloji xassələri, aşqarlar, korroziya, sürtgü effekti