saturated compounds was investigated. Aliphatic and aromatic alkenes and alkynes were used as substrates. As a result, products of iodomethoxylation with good yields were obtained. This pathway of creation of aliphatic iododerivatives is enough simple, moreover, it does not require further purification by column chromatography.

### Acknowledgment

This work was supported by a research grant from the Ministry of Education and Science of Russian Federation (project «Science» №4.2569.2014/K).

### References

1. Zhdankin V.V. Hypervalent Iodine Chemistry: Preparation, Structure and Synthetic Applications of Polyvalent Iodine Compounds.– John Wiley & Sons: Chichester, 2013.– 468 p.
2. Zhdankin V.V., Stang P.J. Chemistry of Polyvalent Iodine.– Chem. Rev., 2008.– 108.– P.5299–5358.
3. Hypervalent Iodine Chemistry, (Ed.: T. Wirth), Springer, Berlin, 2003.
4. Yusubov M.S., Zhdankin V.V. Curr. Org. Synth., 2012.– Vol.9.– P.247–272.
5. Atmaca U. et al. Tetrahedron Lett. 2014.– Vol.55.– P.2230–2232.
6. Uyanik M., Akakura M., Ishihara K.J. Am. Chem. Soc., 2009.– Vol.131.– P.251–262.
7. Yusubov M.S., Yusubova R.Y., Nemykin V.N. et al. Eur. J. Org. Chem., 2012.– P.5935–5942.

## Research mechanical and tribotechnical properties of composites “uhmwpe-ptfe”

Nguyen Xuan Thuc
Scientific supervisor – DSc, Professor, S.V. Panin

*National Research Tomsk Polytechnic University*
*Russia, 634050, Tomsk, 30 Lenin Avenue, nxthuc1986@gmail.com*

In order to develop solid self-lubricating composites based on ultrahigh molecular weight polyethylene (UHMWPE) matrix, we studied mechanical and tribotechnical characteristics of the blends “UHMWPE+Polytetraflu - roethylene” under dry friction. Recently micro- and nanocomposites on the basis of (ultra) high molecular weight matrix (for example, UHMWPE) are widely developed and studied [1–3]. It is known that polytetrafl oroethylene (PTFE) is antifrictional polymer with lowest friction coefficient among structural polymeric materials.

The UHMWPE powder (GUR-2122 by Ticona) with the molecular weight of 4.0 million carbon units and particle size of 5÷15 μm, Polytetrafl - orethylene powder (F-4PN20 – ∅14 μm) were employed in the study.

Table 1 shows the tribotechnical and mechanical properties of UHMWPE and “UHMWPE-PTFE” composites. It is seen from the table that Shore D hardness of “UHMWPE + n wt. % PTFE” specimens varies slightly in comparison with pure UHMWPE. With decreasing weight fraction of PTFE the tensile strength and elongation at failure decrease while the density increases.

Figure 1 shows the diagram of wear intensities (I, mm2 / min) of the above mentioned compositions.

As is followed from Fig. 1, the wear rate of UHMWPE-PTFE compositions depends on the weight fraction of the fille . If this takes place the lowest wear rate is characteristic for the composition of UHMWPE + 10 wt. %

**Table 1.** Mechanical properties and friction coefficient of UHMWPE-PTFE compositions of the filler powder

| Filler content wt. % | Density g/cm$^3$ | Shore D hardness | Tensile strength σ, MPa | Elongation ε, % | Friction coef. *f* |
|---|---|---|---|---|---|
| 0 | 0.93 | 59.5±0.6 | 32.3±0.9 | 485±23 | 0.12 |
| 5 | 0.97 | 9.8±0.5 | 29.2±1.0 | 465±23 | 0.067 |
| 10 | 1.00 | 9.6±0.6 | 27.0±1.2 | 428±25 | 0.067 |
| 20 | 1.06 | 9.7±0.6 | 24.7±1.3 | 406±24 | 0.068 |
| 40 | 1.22 | 9.8±0.6 | 20.2±1.0 | 217±23 | 0.075 |

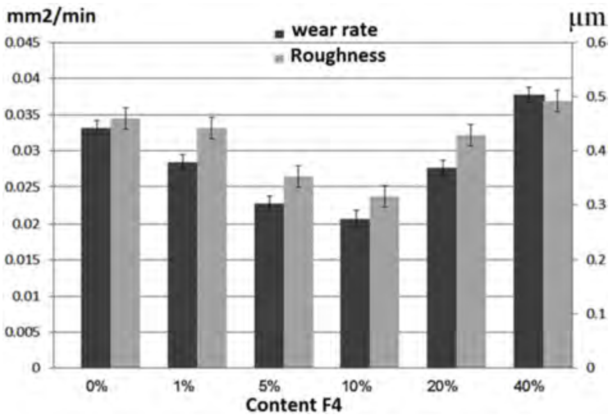


**Fig. 1.** *Wear rate (I) and surface roughness μm of the wear tracks (Ra) of UHMWPE and UHMWPE-PTFE compositions*

PTFE (column 4). Wear track surface roughness of the composition UHMWPE+10 wt. %PTFE is also the lowest. Thus, despite a slight decrease in tensile strength, UHMWPE-PTFE composite is characterized by more than double increase in wear resistance under dry sliding friction.

## References

1. Harley L. Stein. Ultra high molecular weight polyethylene (UHMWPE) // Engineered Materials Handbook, 1999.– Vol.2: Engineering Plastics.
2. Panin S.V., Kornienko L.A., Sergeev V.P., Sonjaitham N., Tchaikina M.V. Wear-Resistant Ultrahigh-Molecular-Weight Polyethylene-Based Nano- and Microcomposites for Implants // Journal of Nanotechnology, Volume 2012 (2,012), Article ID 729756, 7 p.
3. Krasnov A.P., Aderikho V.N., Afonicheva O.V., Myt V.A., Tikhonov N.N., Cornflowers A.Y., Said-Galiev E.E., Naumkin A.V., Nikolaev A.Y. // About ordering nanofill rs polymer composites. Friction and Wear, 2010.– Vol.31.– №1.– P.93–108.

# Investigation of contaminated soil by oil of Shapshinskaya group of oilfields

E.E. Pechenov
Scientific supervisors – PhD, Associate Professor, A.I. Levashova;
PhD, Associate Professor, M.V. Kirgina

*National Research Tomsk Polytechnic University*
*Russia, 634050, Tomsk, 30 Lenin Avenue, pechenove@yandex.ru*

Today the problem of protection natural environment as a whole, and in particular treatment of soils from oil pollution is quite acute, which defines relevance of the topic [1]. Despite the use of modern technologies in the field of production, transportation and refining of petroleum hydrocarbons the level of pollution of the environment remains very high [2]. Physical and chemical properties and structure of biocenosis are change after contact oil and oil products with soil.

The aim is to research oil-contaminated soil and study the effect of oil pollution on the enzymatic and microbial activity of the soil when it is self-healing.

For the experiment were taken two samples of oil from Shapshinskaya group of oilfields of Khanty-Mansiysk Autonomous Okrug (Khanty) with a viscosity of 15 $mm^2$/sec sec and a density of 0.868 g/$sm^3$ at 20 °C. In two containers with a mass of 0.465 and 0.425 kg fertile soil were added samples of oil at a concentration of 7% (70 g/kg) 15% (150 g/kg). Within 60 days