

Nano-Materials Based Solid Mineral Anti Friction Technology for Improving Efficiency & Reliability

Problem:

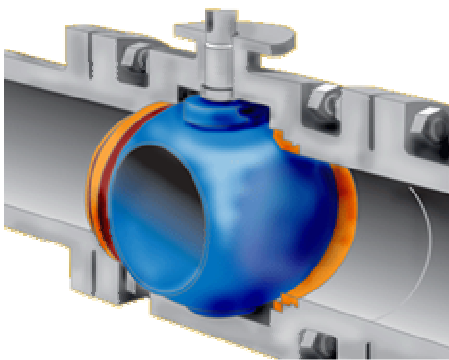
Friction and wear were named the most challenging problem across European and Russian industrial companies. Friction results in losses of fuel and energy. Wear enhances corrosion, and corrosion enhances wear. Many mechanisms work in conditions of abrasive wear caused by dust. Often scuffing is a problem. Wear, scuffing and corrosion of metal parts can cause frequent repairs with high maintenance and downtime costs.

Examples of objects that need protection from wear and corrosion:

Turbines, Engines, Diesel Engines, Gears, Pumps, Bearings, Compressors, Ball Valves, Extruders

Technical solution:

Nano-Technology based Mineral lubricant coatings working at high temperatures and pressure, providing low friction, protection from corrosion, scuffing and abrasive wear.



Advantages:

- Much Lower energy/fuel consumption (15-20% for used cars, 7-8 % for compressors);
- 2 times lower lubricating oil/grease consumption;
- Higher reliability; Service life at least 2-4 times longer;
- Lower emissions;
- Easy cold start;
- Lower sensitivity to the quality of lubricating oil;
- Economy: 12 % of machine price annually;

80 minerals were identified as **solid lubricants of natural origin**. These are ribbon and layered silicates, minerals based on oxides of Si, Zr, Al, etc. Numerous tribological experiments confirmed extremely low friction and wear of these mineral solid lubricants. Their adhesion to metal is high, whereas adhesion between layers is low. **Innovative** techniques of metal surface treatment are used: the coating is applied to any metal by mechanical methods at room temperature.

The coatings are characterized by **low friction** (friction coefficient down to 0.005 in oil);

High wear resistance (wear down to $5 \cdot 10^{-14}$);

High thermal stability (1300 °C);

High corrosion resistance (7 years at a geothermal power plant, in hot vapour with salts and H₂S);

Green alternative to chromium;

Protection from scuffing;

Protection from abrasive wear.

Antifriction coatings provide good performance in an emergency situation – engine can continue working for certain time under oil leakage conditions. Mineral solid lubricants can be used in aggressive media (sea water, hot vapour), in conditions of limited aqueous lubrication, border friction and abrasive dust.

Fields of application:

Transport, power generation, mining industry, agricultural machines, oil and gas, chemical, cement and paper industries, metallurgy.

At present nano-material based coatings are industrially being supplied by us to **Power Generation Industry and Navy.**

Products and services:

- **Oil with solid lubricant;**
- **Grease with solid lubricant;**
- **Service of applying coating on metal in friction pairs;**
- **Mass production of metal parts with mineral coating – Technology Transfer;**

Mineral coatings are especially efficient for heavy-duty applications, for example, for vehicles in open mines which often work in the conditions of dust, for pumps which are exposed to aggressive liquids and for extruders in which heat, pressure and constant flow of materials cause fast wear of the screw and of other metal parts.

A simple and fast method of applying solid lubricants is to use fine mineral particles as an additive to lubricating oil. The mixture is introduced into the lubricating system of the mechanism. Thin film (10-50 μm) of mineral coating is gradually formed on the surfaces of metal parts of friction pairs under the influence of pressure developed during routine work of the equipment. If time and money allows, one can apply mineral coating to the friction pairs during capital repair work, when equipment is disassembled. Non-abrasive ultrasound surface treatment is exploited. Roughness down to values of R_a 0.1-0.025 can be attained with the help of this innovative approach.

Mass production of metal parts with a mineral coating requires technology transfer and reliable supplies of the coating material. Responsibility of mineral powder treatment, characterization and supplies is comprehensively undertaken by us. The process can be easily scaled up.

Economic Estimates: costs of coating application never exceed 20 % of the positive economic effect.



Example: For a locomotive diesel, fuel economy of 4 % was observed, which was 5 tons per month.

For an average price of 1 400 € per ton of diesel fuel, it makes 7 000 € per month and **84 000 € of annual savings.**

Costs of applying solid lubricant – **8 000 €.**

