ECOLOGICALLY SAFE TECHNOLOGIES FOR GOODS LIFE CYCLE SUPPORT

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New technologies for goods life cycle support are proposed. These technologies are based on the modern approach to the production system concept that represents the goods consisting of the following cycles, production, distribution, consumption and wastes utilization. Proposed methods allow providing ecological safety of the goods during each of these cycles.

Technologies are based on laser application. This entails active surface layer properties modifying that allows to increase machine service life.

The most important concept of proposed technologies is their ecological safety. For example, harmful matter atmosphere apportionment of the proposed technologies is 8 times lower as compared with the cyanidation . Experiments and industrial application indicate that the service life of machines junctions treated according with proposed technologies, increases on 30-40% depending on the working conditions.

The modern approach to the production system concept is based on its consideration as an opened system. Broadened production system, therefore, is considered only together with the concept of the good and represents the complex good with its life cycle. The life cycle, in its turn is divided into several phases variations, but in any case among is the structural constituents there the production of the goods, the goods repair and maintenance and the goods utilization, that is the final life – cycle phase. Just these three phases are supposed to have the most careful approach to the question of the goods ecological safety.

In the goods manufacture and repair, the use of the ecologically harmful and dangerous for the man's health technologies is inevitable. This negative influence manifests in the form of the manufacturing industry wastes (metal chips at grinding, metal dust at grinding and drilling out repaired goods to achieve repairing dimension, etc.) Besides, being in up-to-date use methods of the goods are not ecological themselves manufacturing and repairing.

In modern mechanical engineering cyanidation (nitro – cementation) widely used for details working surfaces hardening. The essence of this treatment method includes details surface layer saturation by carbon and nitrogen compounds. The nitro – cementation disadvantage is the higher cost of the process as compared with other types of the chemical – thermal treatment. It's caused by the necessity of the strict industrial safety rules observance because of cyanic salts (NaCN and KCN) or gas ($CH^4 + NH^3$) high toxicity. Also, expensive equipment for performing this process is necessary needed (hermetic containers, atmosphere – harmful matter content control gages, an isolated ventilation system, a special harmful matter protection for workers, etc.)

It is necessary to emphasis especially the negative influence of this

method, on the environment on in thee other words, the low ecological safety of it. This influence manifests in such important goods life cycle phases as the manufacture, the repair, the maintenance and the utilization. Owing to this there is the necessity of such new technologies working out to provide and support the goods (machines, in particular) life cycle with ecological safety.

In Volgograd state architectural-building university the methods of contacting machines parts surfaces hardening with laser technologies application were worked out. The following laser treatment advantages were brought to light during the investigation:

1. High energy concentration gives the opportunity to treat (according to the special program, id needed) only small volume of undersurface zone without the other volume heating and its structure and properties breaking. This minimizes details war ping owing to residual tension.

2. High speeds of treated material heating and cooling down. This enables to create different structures of the surface working layer from usual tempered structure to high dispersion and even amorphous structure.

3. Possibility of the massive and large – scale details treatment.

4. Absence of the mechanical forces applied to the details during the treatment. This enables to treat thin and breakable details.

5. Respective process automation simplicity and harmful wastes absence.

In addition, it is necessary to mention the more hardened zone depth at the laser treatment (h=1-1,5 mm) as compared with the cyanidation (h=0.6-1,0 mm).

The surface laser treatment technology gives an opportunity to modify the active surface layer properties. Such working condition of the thermal treatment are selected that surface hardening is performed without deep material melting. This technology was named the selective laser hardening because there wasn't done the complete treatment of entire surface, but only the thermal-treatment "tracks"were performed. Depending on the direction and configuration of these "tracks" it is possible to increase (immovable junctions, for example) or to reduce (journal bearings and machine - tools slides, for example) the friction coefficient.

The experimental results affirmed these technologies effectiveness. It is determined that the life cycle of the machine treated with this mode use increases at the expense of the phase of the application and the utilization extension. The service life in this way increases on 30-40% depending on the working conditions.

For example, the main service life criterion for the bolt junction is the resistance to shear and deformation. Fig.1 reveals the laser treatment influence on the tangential stiffness of junction and the resistance to shear. The tangential safeness is a function of maximum shear strain τ_{max} before sliding initiates. The tangential stiffness is a reverse function of the asperities presliding shear deformation. The harmful matter atmosphere apportionment is 8 times lower as compared with the cyanidation.

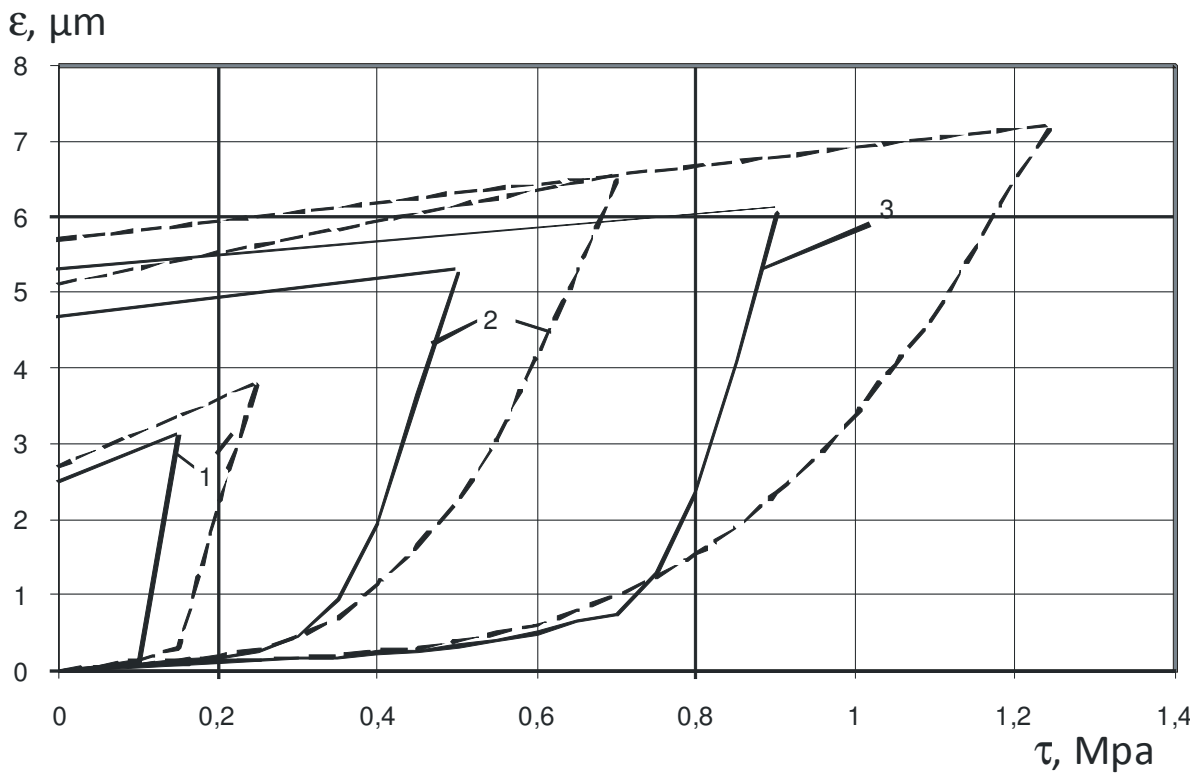

Figure 1. Presliding deformation ε versus shear strain τ for various volumes of normal pressures σ (plane contact of metal parts)
_____ no laser treatment;
- - - - - - - - after laser hardening;
1 - σ = 1 MPa; 2 - σ = 2 MPa; 3 - σ = 3 MPa.

These technologies application gives the opportunity of the more through realization of the life cycle control main functions: the quality guaranteeing (the phases of the goods manufacture, the application, the utilization), the making (the goods technical preparation and the manufacture), the maintenance (the application and the utilization phase), etc.

Thus, the investigations witness that the laser technologies can become one of the links in the measures system for ecological safety providing not only in the engineering industry, but also in all industry branches associated with the goods life cycle support.