When it was decided to build the Volzhskii Automobile Plant (VAZ) domestic industry did not have appropriate experience in the heat treatment of automobile parts under conditions of large-scale production. For this reason, the contract with the FIAT firm (Italy) envisaged that the basic heat treatment shops and departments would develop the technology of heat treatment of automobile preforms and parts. This project was created with active participation of domestic specialists in the field of heat treatment. The thermoelectroplating shop was designed by the Giproavtoprom Institute.

In the thirty years of existence of the plant the production has undergone many changes, and new car models required new materials and technologies. For example, the mass of parts (per car) subjected to chemical heat treatment has increased from the designed 22 kg to 37 kg. The initial heat treatment technologies of the parts were radically reconsidered.

At the present time the total area of heat treatment shops and departments in AvtoVAZ has increased by a factor of 1.5 relative to that initially designed by FIAT and amounts to 36,000 m² (without the 80 bays for high-frequency current treatment in the lines for mechanical processing). The total number of furnace heating units in AvtoVAZ exceeds 110, of which 56 are large and small automatic through-type furnace lines, 19 are chamber furnaces, 6 are vacuum furnaces, etc.

New heat treatment procedures have been mastered, an example being short-duration gas nitriding (carbonitriding) of the basic parts and tools. Installation of this process, which is conducted at 570–600°C in a mixture of exogenic gas and ammonia, made it possible to eliminate completely the process of chemical heat treatment in cyanides, increase the productivity of the equipment and the quality of the parts, and improve the environmental conditions. Technologies for nitriding cermet hubs and remelting the functional surface of camshaft cams in order to obtain a wear-resistant ledeburitic structure have been developed. The remelting is conducted in special installations of the AEG-Elotherm firm by a tungsten-thorium electrode in a medium of protective gas. A special cast iron with vermicular graphite has been developed in order to produce a high-performance ledeburitic layer 0.8–1.0 mm thick.

A technology for forging, isothermal annealing, and cyaniding of conical gears of the back axle has been suggested that provides optimum conditions for the contact spot (deformation) of the teeth; particular specifications have been worked out for steel 20KhGNI used for these parts and supplied by the Belarus Metallurgical Plant and the Oskol Electrometallurgical Works.

High quality for the parts can be guaranteed only if the heat treatment operations are strictly carried out with subsequent monitoring.

In the forging department steels are heated for forging only by the induction method, which provides a uniform grain size and eliminates the formation of a decarburized layer.

All forgings for gears and shafts are subjected to isothermal annealing and subsequent chemical heat treatment. This provides a uniform pearlite structure, creates favorable conditions for cutting, and decreases quenching deformations after the chemical heat treatment. The plant widely uses cyaniding in order to obtain saturated layers with a thickness \( h = 0.1 - 1.0 \) mm and carburizing \( h > 1.0 \) mm. Both operations are conducted on automatic transfer lines designed by the Holcroft and Ihelin firms and by the Kurgan plant (from triple-row six-zone to double-row double-zone). The chemical heat treatment is conducted in a controlled atmosphere based on endogenic gas and 20% H₂ with an automatically controlled composition.

All gears are subjected to shotblast cleaning in order to remove retained burrs and create compressive stresses on the surface.

The majority of forgings are heat-hardened in the forge shop. For the most part these are forgings further hardened after HFC heating in the mechanical flow line.

Cold forging with subsequent carburizing is used for piston pins, front-drive hinge casings, and other parts. This has made the manufacturing process less laborious and made it possible to reduce its area. Before chemical heat treatment preforms are subjected to spheroidizing annealing in Holcroft and Humbert installations in a medium of exogenic gas.
Heat treatment of automobile parts involves special processes, for example, thermomechanical treatment of coil springs and valve and clutch springs. These parts are processed using special equipment supplied by the Olivotto, Permofusa, and CFI firms and installations designed by AvtoVAZ specialists.

The plant has installed technology for ion nitriding of engine valves that uses equipment supplied by the Klekner and Eltra firms. This kind of chemical heat treatment is being used in large-scale production for the first time in world practice.

Equipment for conduction quenching of teeth of steering racks is supplied by the Thermomakino firm. It is not possible to mention all the processes used in a short review.

Heat hardening of parts and castings is conducted in trough-type furnaces of the Holcroft firm and chamber furnaces with a precombustion chamber of the Lindberg firm. The high quality of the heat treatment of small spring parts of steel 70 and various clamps deserves special mention. Their quenching and tempering is conducted in special furnaces supplied by the Ferre firm and modified at AvtoVAZ. Heat treatment in these furnaces with a controlled atmosphere provides stable quality for the parts and a high output.

It should be noted that induction hardening is used quite widely. Over 100 kinds of products from crankshafts to engine valves are subjected to this operation.

An original kind of heat treatment is used for nuts, bolts, screws, rivets, and other fasteners. It is conducted in a heat-treatment shop with an area of 15,000 m² in the Avtonormal Plant (Belebei), which is a part of the AvtoVAZ JSC. The heat treatment is conducted in through quenching-and-tempering furnaces, and the chemical heat treatment is conducted in furnaces designed by the All-Russia Research Institute of Electrothermal Equipment (VNIIÉTO), the Saratov Plant for Electrothermal Equipment, and the Ihelin and Holcroft firms. All fasteners are processed in a controlled atmosphere prepared in ÉN-type endothermic generators. It should be noted that the requirements imposed on fasteners are very strict and each bolt is marked on the head by a stamp of guaranteed strength. The fasteners are manufactured by the method of cold heading, which requires high-quality metal with respect to both the chemical composition and the presence of surface defects. Special requirements are imposed on the grain composition of the ferrite-pearlite structure. In order to meet these requirements the steels to be used for manufacturing fasteners are subjected to spheroidizing annealing in bundles in a protective nitrogen-base medium in the heat-treatment shop of the Avtonormal Plant. The preparation of the metal structure before the heading and the cold heading and the finishing heat treatment with hardening in oil or in an aqueous solution of caustic soda provide fasteners with stable mechanical properties. In the last five years the plant has been using boron steels of grades 20G2R and 30G1R that possess σu = 800 – 1000 N/mm² instead of steels 35, 40, 38KhGNM, 40KhGNM.

Mechanical processing in automatic lines requires tools of very high quality. High-speed tool steels are heat treated in a special shop equipped with quenching, tempering, and surface-impregnation installations produced by the Degussa firm, vacuum-heating installations produced by the Heis firm, salt tanks, and other devices. The use of this advanced equipment guarantees high quality for the heat treatment under the condition that the manufacturing technology of the tools is...