NEW DOMESTIC EQUIPMENT FOR CONTINUOUS PRODUCTION OF VISCOSE FIBRE

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Two new domestic models of a machine for continuous manufacture of viscose fibre are examined. Each model has two modifications — for production of twisted and untwisted fibre. The degree of novelty and standardization of the models differs, but their fundamental functional units are the same. The models differ in the design of the drying devices, and their modifications have a different execution of the finishing, sizing, and oiling devices. The models are as good as similar imported equipment and much better than domestic equipment with respect to the efficiency and basic technical and economic indexes.

The need to create domestic equipment for manufacturing twisted and untwisted viscose fibre is due to the world trend toward development of this kind of stock.

The program of the Executive Committee of the Union of Belarus' and Russia entitled “Organization of Mass Production of Equipment for Manufacture of Chemical Fibres” provided for modernization of the MN-90-I2 domestic continuous spinning and finishing machine. The following problems were posed:

- expanding the assortment of viscose fibres, including manufacture of untwisted fibre in packs of higher weight;
- creating or purchasing modern stock articles for the machine;
- developing power-saving processes for continuous spinning machines;
- searching for new methods of localization and treatment of gaseous emissions to increase the environmental safety of the viscose process.

Within this program, Viskoza ANITs, Svetlogorsk Khimvolokno Industrial Association (SIA), and K. Marx Machine-Building Association (MO) developed two types of standardized machine: the MN-110-I and MN-110-IN — for manufacturing twisted and untwisted fibre. The MN-90-I2 machine operating at Khimvolokno SIA was used as the basis for standardization. One section in the 18 work stations of this machine was refitted for manufacturing untwisted fibre. The section was equipped with model EKS takeup-winding devices purchased from Spinnzwirn-Barmag (Germany). After performing structural and process tests on the machine, test batches of untwisted fibre were processed at textile plants. A modification of the MN-110-I-Soyuz machine was subsequently manufactured at K. Marx MO for manufacturing twisted fibre alone. It should be noted that both the MN-110-I and the MN-110-IN machines do not satisfy the requirements set by the Program. Their output was 10% lower than for the MN-90-I2 machine, since the number of work stations was reduced and the fibre output rate remained the same. The dimensions of both types of machines and the production process remained as previously, and the installed capacity varied insignificantly.

The competitiveness of the MN-90 and MN-110 machines on the world market is low due to the unsuccessful structural configuration, imperfection of the production process, poor maintainability, low fibre manufacturing rate, insignificant pack weight, and relatively unsuccessful solution of problems of localization and regeneration of the carbon disulfide and hydrogen sulfide separated in the production process.

All of the above required developing new domestic equipment for continuous production of viscose fibre in 2000. The acute need for a new machine was dictated by the necessity of overhauling old and creating new viscose fibre plants both in Russia and neighboring countries. Work on creating such a machine was initiated based on the Program of the Executive Committee of the Union of Belarus’ and Russia, investigation of materials from foreign firms, and utilization of accumulated personal experience. The creation of a new machine should make it possible to organize production of twisted and untwisted
viscose fibres in a wide range of linear densities, manufactured in packs of higher weight, and operating at a high speed. Equipping the machines with modern stock items and perfecting the production process will allow them to compete on the world equipment market.

At present, two different models of the machine for continuous manufacture of viscose fibre have now been put together and offered. Each model of the machine has two modifications that basically differ in the take-up-winding mechanisms. The first modification is designed for manufacturing twisted fibre in packs using domestic electric spindles with a ring-twisting mechanism, and the second modification is designed for manufacturing untwisted fibre wound on a model EKS 203 take-up-winding mechanism from Spinnzwirn-Barmag. A variant of the original domestic spindle-type takeup-winding mechanism, which requires experimental testing, is provided in the second modification for winding untwisted fibre into a pack.

The first model of machine is wide and has an internal passage for technical servicing. The washing and finishing mechanism has an increased fibre spreading length on paired transverse rollers with intersecting axes. Mechanisms for application of sizing and oiling solution are additionally incorporated in the design of the machine. The drying mechanism is in the form of transverse paired rollers at each work station with individual feed of the heat carrier to one of them. The machine’s drive and frame have an original design.

The second model of machine is narrow, with no internal passage. The washing and finishing mechanism has a shortened fibre spreading length laid out on paired transverse rollers. The first modification of this model has a mechanism for brightening (finishing) treatment in the form of a “squirrel cage” with an external shell made of polytetrafluoroethylene fabric in contact with the fibre. The conveyor and drying cylinders are longitudinal, borrowed from the mass-produced MN-90-I2 machine in shortened form. The machine’s frame is borrowed from the mass-produced PN-300-V3 machine. The transverse roller housings, with insignificant additional machine, are also borrowed from the same machine.

A takeup godet wheel that fixes the fibre before drawing is provided in the design of the first modification of the second model of machine after the fibre spinning mechanism along its path. The second modification contains the same basic units as the first modification except for the takeup godet wheel. In addition, it has a device for sizing the fibre (other design) and a mechanism for oiling and encapsulation of the drying zone. This modification has the same composition of the borrowed components, assembly units, and parts.

Both models of machine and their modifications are designed for high-speed spinning of viscose fibre. The coagulated fibre is automatically carried by the spinning bath stream through the horizontal spinning tube of the spinning mechanism, whose length and diameter provide for drawing of the fibre and giving it the necessary physical properties during high-speed spinning.

The spinning mechanism is executed so that the free spinning bath surface is eliminated or reduced to the maximum. The as-spun fibre coming out of the spinning tube passes through a squeezing apparatus that reduces the amount of spinning bath captured with the fibre.

The preliminary reduction unit, in the form of paired shortened power-driven transverse rollers with intersecting axes at each work station, is designed for loading one or two fibres on them. The preliminary reduction solution is fed to the fibre coil by spraying. A section pan or individual pans are positioned under the lower rollers in each section to collect used liquid.

The device for cascade washing of the fibre in the form of paired, elongated, power-driven transverse rollers with intersecting axes at each work station is designed for washing one or two fibres. The lower roller in each pair is partially immersed in the front part of the cascade pan, individual for each work station. The fibre is washed by dipping the initial fibre coils in the solution partially contaminated by the components and spraying the final coils with clean washing liquid. The partially washed fibre coils encounter cleaner liquid as they move along the rollers and the spent liquid with a high concentration of components collected in it moves along the cascade pan to the fibre (fibres) input and is subsequently directed to preliminary reduction or regeneration.

The method of applying sizing on the moving fibre or oiling it after drying is determined by the requirements (regulations) of the industrial process conducted on the particular modification of the machine. The mechanisms and devices for conducting these operations differ, and they are selected by the purchaser of the machine.

The design solution for the drying part of the machine is determined by the model (see above). The variants of the process solution for the drying mechanism in each model of the machine determine its novelty or degree of standardization (borrowing) from other machines.

The twisted fibre is wound into a pack on each model of machine (first modification) on an EVS-II electric spindle with a three-phase synchronous motor of the hysteresis type (rotation rate of 8000 rpm, power of 40-70 W, finished pack weight of 2.5-3.0 kg). The use of electric spindles of this type allows significantly increasing the energy indexes and increasing the duration of reliable operation of the machine. Tests of an experimental batch of EVS-II electric spindles and the PUSG-2 starter conducted at Khimvolokno SIA produced positive results.