Systems for stabilizing individual process parameters have been adopted, for the most part, in Russian production of synthetic fibres. These systems enable the quality of the finished product to be improved and raw materials and electrical power to be reduced. Automation has been introduced in varying degree in Russian cellophane production. Some plants have not been modernized and automated equipment is almost entirely absent. Other plants have automatic equipment for controlling the temperature of the solutions in all vat machines, for adding solution to the coagulating baths (in relation to the speed of the machine), for the subsidiary processes and so on.

One of the present problems is that of stabilization of the concentration of solution at the finishing processes and at the coagulating baths. The Barnaul branch of the Experimental Design Office for automation (OKBA) have developed and have introduced automatic systems for controlling the concentration of plasticising, desulphurising and acidification solutions in cellophane production (Figs. 1 and 2). Desulphurising and acidification solutions are reconcentrated at the vat machines, solutions for the plasticising baths are reconcentrated in a special tank.

While the problem of stabilising the concentration of the finishing solutions may be considered to be solved and we are, now, merely concerned with bringing automatic control systems for this purpose up to date, it cannot be said that the problem of stabilising solutions in coagulating baths has been equally resolved. No devices are yet available for measuring sodium sulphate and sulphuric acid concentrations at the coagulating baths themselves which can be considered accurate enough to meet the very stringent requirements for stabilisation.

The Kiev Institute for Automation has developed a system for stabilising density in coagulating baths. This employs a RKSh density meter [1]. The problem of stabilising the concentrations of the individual components in the baths remains to be resolved.

One of the most pertinent problems in producing high-quality cellophane is that of automating the film drying processes. This problem is made difficult through lack of reliable Russian-made instruments.

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Fig. 1. Block diagram of automatic concentration control system for glycerine solution. 1) Soft water supply; 2) glycerine solution supply; 3) steam supply; 4) feed heater; 5) condensate discharge; 6) drain from vat machines for glycerine solution and from controller; 7) collecting tank for glycerine solution; 8) concentrated glycerine feed; 9) film proceeding to drying section of machine.

Fig. 2. Block diagram of automatic concentration control system for desulphurising solution. 1) Concentrated alkali supply; 2) film; 3) ready use tank; 4) control piping.
capable of giving a direct reading of moisture content in the film while the film is actually being produced. Neither do foreign-made machines offer devices for measuring moisture content. This parameter has to be controlled by indirect methods.

In the case of OA type machines, a given moisture content in the film is maintained by controlling the temperature and humidity of the air in the drying and post-conditioning zones. The temperature of the dryer calenders 1 in the first section of the dryer 2 is automatically controlled by the amount of stretch in the film (Fig. 3). The amount of stretch is determined by means of a movable cylindrical roll or "dancing roll" 3 which lies on the surface of the film. Change in moisture content alters the tension in the film and causes the "dancing roll" to be displaced in the vertical direction. Mechanical displacement of the "dancing roll" is converted into a pneumatic impulse by the controller 5 which regulates the supply of the heating medium to the dryer cylinders. Under static loading, displacement of the roll is proportional to the tension developed in the film.

A "dancing roll" cannot, however, provide unambiguous measurement of tension since it is, itself, subject to oscillation in the vertical direction and, so, does not ensure accurate control. Humidity control in the dryer zones and in the conditioning chamber 3 (Fig. 4) can be effected by pneumatic systems employing psychrometers as sensing devices. Variation in temperature at the dry-bulb sensing element 4 causes the pneumatic temperature transmitter 1 to feed a signal to the controller 5 which alters the supply of circulating drying air; variation in temperature at the wet-bulb sensing element 4 causes the controller to call for change in the steam supply.

Indirect measurement of humidity does not solve the problem of producing film with a given moisture content. Instrumentation is required which will measure the moisture content in the cellophane film itself, the concentrations of the components in the coagulating bath, automatic analyzers for the viscose composition and, also, instruments which can give some idea of the quality of the finished film.

Considerable attention has been given to automation of cellophane production in the USA, where cellophane is one of the chief packaging materials. At one factory [2–4], where the major part of the production operation, from forming the viscose to winding the film onto rolls, is continuous, the whole production process is automated. More than 95% of the 2000 variable parameters which must be regulated are controlled automatically [5]. Some 60 parameters are continuously monitored at each of the ten cellophane machines. These parameters include: purity of water as it is supplied, temperature, moisture content of the film, speed of the machines, viscose pressure, velocity of jet, concentrations of finishing solutions, percentage ratios of the different components forming the coating layer of the film, supply and removal of heat in the dryer and stabilising sections of the Ross coating towers, and so forth.