PROTECTION OF THE ENVIRONMENT

QUANTITATIVE ASSESSMENT OF THE GAS GENERATION IN THE ENCLOSED SPACE OF MACHINES PRODUCING MAN-MADE FIBRES

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The gas generation in man-made fibre production is determined from the content of noxious substances in the fibre or tow at various production stages. No account is taken of the distribution of the gas generation in the enclosed space of the machines because the fibre samples for analysis are extracted in the end section in order not to interrupt the technological process.

In the sampling of fibre for analysis the gas generation losses vary with the temperature of the fibre or tow. On a test rig with a single charged working position or machine section the data relating to the gas generation cannot be obtained because it is not possible in this case to extract the volume of fibres needed for the analysis.

A direct determination of the noxious substances in the air ducts makes possible a quantitative assessment of the gas generation in the main stages of the production process but only if the ventilation is efficient so that no noxious emissions leak from the enclosed spaces of the machines into the workroom.

To determine the efficiency of the ventilation system of machines producing man-made fibres it is necessary to know the gas volume extracted through the air ducts for scrubbing, the volume of unscrubbed gases emitted through the ventilation stack, and the gas volume emitted in unit time from the openings in the machine to the zone of the operative [1].

In the design development of local ventilation systems to be installed as near as possible to sites of gas generation it is necessary to know the gas generation distribution in the enclosed space. A sampling device was constructed for this purpose which consisted of a cylinder cut lengthwise into two parts; the yarn (or tow) passes along the inside of the cylinder. The sampling device (or trap) is equipped with a connection for the extraction of gas for the analysis.

The sampling devices vary in diameter and length depending on their purpose. They can also be used to determine the gas generation from the surface of the precipitation bath and from the rotating godets with the yarn (tow) for which purpose the half of the device containing the connection is placed on the surface of the precipitation bath or on the inside face of the godet.

The investigation of the enclosed space with a trap showed that the main site of gas generation is the yarn (tow) and not the precipitation bath [2]. The amount of gas emitted by the yarn (tow) and determined with the trap is calculated from the equation

\[ C = \frac{m \alpha L Q_0}{1000 \cdot 1000} \]

where \( C \) is the amount of gas emitted by yarn (tow) of length \( L \), g/h; \( m \) is the amount of substance emitted by the yarn (tow) and collected with the trap in 1 min, \( \mu g/\text{min} \); \( \alpha \) is the diameter/length ratio of the trap, viz. 0.3; \( Q \) is the rate of gas sampling for the analysis, liter/min; \( Q_0 \) is the corrected rate of gas sampling, viz. 1 liter/min.

The areas bounded by curves in Figs. 1 and 2 can be used to calculate the total gas emitted by the yarn (tow).

The diagram in Fig. 1 shows the gas generation from the tow in a single section of the modernized spinning machine ShA-25-IR with a single taking-up godet in the section. The first peak indicates the gas genera-
Fig. 1. The gas generation from the tow in the enclosed space of a machine producing viscose rayon staple fibre: 1) carbon disulfide and hydrogen sulfide in terms of carbon disulfide (aggregate amount); 2) carbon disulfide; 3) hydrogen sulfide in real terms.

Fig. 2. The volume of dimethylacetamide and dimethylamine in terms of dimethylacetamide emitted in the enclosed space of a machine producing polyacrylonitrile fibre.

tion from the single tows passing from the surface of the precipitation bath to the gathering hook. The second peak expresses the gas generation from the godet. The diagram shows that carbon disulfide is given off in greater quantities from the rotating godet. The individual tows give off more carbon disulfide than hydrogen sulfide.

These relationships exist also in the production of viscose rayon textile yarn on centrifugal spinning machines. The yarn emerging from the precipitation bath is taken up by a pair of rotating godets situated one below the other. From the top godet it passes into the centrifugal spinning pot.

Gas was extracted for analysis with the trap at six points along the yarn route in the enclosed space: from the yarn section between the precipitation bath and the taking-up roll; from the yarn section on the lower godet; from the yarn section between the two godets; from the yarn section on the upper rotating godet; from the yarn section leaving the upper godet; and from the yarn section about to enter the spinning pot.

As in viscose rayon staple fibre production hydrogen sulfide is generated mainly on the lower godet after which its generation decreases sharply. The proportion of carbon disulfide generation increases in both cases. Carbon disulfide is given off fairly evenly along the entire length of the yarn (tow) starting on the first godet. The diagram in Fig. 1 shows the gas generation from tow within a single section.