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PROCEDURE FOR EVALUATING OPERATING VISCOSE FIBRE MANUFACTURING
PLANTS FOR THEIR CONFORMITY TO LOW-WASTE AND WASTE-FREE TECHNOLOGY

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A cardinal decision to the problem of protecting the environment in viscose fibre plants
is converting them to low-waste and waste-free technology. Traditional methods of planning,
devising, and operating industrial plants have been aimed for a long time at ensuring the
manufacture of a basic form of product without considering the amount and quality of the
wastes formed. The intensive development of industry in recent years has led to a sharp in-
crease in the amount of various wastes which are discharged into the atmosphere, contaminat-
ing not only surface, but also subterranean waters. Much waste is discharged to dumps.

The basic method reducing the harmful action of discharges from industrial plants to
the environment is introduction of treatment plants, whose purpose is to render harmless
a definite amount of harmful or toxic components in off-gases or wastewater. It has been
assumed that the amounts of contaminants remaining after clean-up are not dangerous to the
environment. Treatment of wastes to render them harmless has been effected in the direction
of devising new systems for cleaning up wastewater or gaseous discharges, which have been
provided at the final stages of technological processes, but have not assured their utiliza-
tion. But today it has become increasingly clear that the future belongs to new technolo-
gies, which will assure all-around utilization of raw material as a result of devising closed
manufacturing loop.

At present an inventory of wastes in all branches of industry has been carried out, and
methods developed for their utilization and extraction of valuable raw material from them
with complete harmlessness of the manufacturing operation are widely used. A coefficient of
waste-freeness has been introduced with the objective of performing an analysis of the opera-
tion of operating manufacturing units and of a quantitative and qualitative evaluation of the
wastes formed. The waste-freeness coefficient (K) is a complex index which characterizes
manufacturing operations from the point of view of their conformity to contemporary require-
ments of rational nature-utilization. It has been formed from elementary components which
characterize manufacturing operations from the point of view of completeness of utilization
of material and energy resources in them, and also the intensity of their action on the en-
vironment, by the principle:

\[ K = f(K_m K_e K_a) \]

where \( K_m \) and \( K_e \) are coefficients of completeness of utilization of material and energy re-
sources, and \( K_a \) is the coefficient of conformity to ecological requirements.

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The coefficient of waste-freeness and its components can vary from 0 to 1, that is, $0 \leq K \leq 1$. The case of complete lack of any by-product and maximum harmful action of the operation on the environment, with complete consumption of material and energy reserves conforms to the value $K = 0$. A value $K = 1$ conforms to the case of complete utilization of material and energy resources for the needs of production only, and lack of any harmful action on the environment.

Calculation of a waste-freeness coefficient is carried out at the following stages: at the stage of operating manufacturing; on completion of manufacturing design; at the stage of experimental or pilot plant manufacture; on completion of scientific-investigative and experimental-constructional work on getting the original data for design.

The quantitative evaluation provides for certification of the manufacturing and technological processes for conformity to the criteria of "waste-free manufacturing," "low-waste manufacturing," or "ordinary manufacturing."

A manufacturing operation is called waste-free if it is characterized by complete or close to complete use of material and energy resources which are involved in processing and by absence of any harmful action on the environment.

A manufacturing operation is considered a low-waste one if it is characterized by a high degree of useful utilization of the material and energy resources which are involved in processing and by a lack of harmful action on the environment.

A manufacturing operation is considered ordinary if, in the absence of harmful action on the environment, the necessary degree of completeness of useful utilization of material and/or energy resources for low-waste manufacturing units is not observed, or if there is a harmful action on the environment at any degree of completeness of utilization of material and energy resources.

The coefficient of completeness of utilization of material resources, $K_m$, is calculated on the basis of data from material balances, technological regulations, accounts on consumption of raw material and other materials with a view of output of product, and can be represented in the following form for an actually realized manufacturing operation:

$$K_m = \frac{P_b + \sum P_s}{M_{bb} + M_{ab} + \sum M_s}$$

where $P_b$ is the output of basic product; $P_s$ is the output of supplemental products; $M_{bb}$ is the basic material of basic manufacturing; $M_{ab}$ is the auxiliary material of basic manufacturing; and $M_s$ is the material of supplemental manufactured products.

Assignment of manufacturing operations to a definite category is carried out on the basis of a graph (see Fig. 1), along whose axis is plotted the capacity for certified production and, along the ordinate axis, the calculated $K_m$ value.

The coefficient of completeness of utilization of energy resources, $K_e$, is calculated on the basis of data for the corresponding energy and material balances, by norms for the consumption of raw material, other materials, and energy resources, formation of losses, wastes, and discharges to the environment per unit of annual production or per annual production capacity or from the consumption of resources in 1 h. Accounting data make up the basic primary information on consumption of energy resources, and also on the formation and utilization of secondary energy resources for operating manufacturing operations.