ENVIRONMENTAL PROTECTION

MODERN TECHNOLOGIES FOR PROTECTING THE ENVIRONMENT FROM WASTES OF THE GLASS INDUSTRY

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A way to create resource- and power-saving technological processes, equipment, and plants that meets modern ecological requirements is suggested. The engineering solutions have been successfully tested and installed in some enterprises.

We have suggested a solution to the problem of creating resource- and power-saving technological processes, equipment, and plants, which meets modern requirements of industrial ecology. The choice between alternative variants of nature-preserving chemical engineering systems is to be made on the basis of prevented damage, the level of reduction of pollution of the environment, and the ecological-economical criterion.

It is known that the production of silicate (including glass fiber) materials is characterized by a feature common for all types of manufactured product, i.e., a large number of functionally different stages of preliminary preparation and processing of multi-component polydisperse powder materials that include from 6 to 12 different components required for transformation of the initial raw material into a semifinished product (glass charge) and of the latter into the final product. All glass technologies consume much power and are ecologically harmful.

Determination and systematization of the special features of different branches of the glass industry allowed us to develop a set of technological measures directed at increasing the efficiency and creating ecologically safe technologies (for glass and other products).

We suggest solving the problems of decreasing harmful gas emissions into the atmosphere, reducing the flows of liquid and solid waste, and recovering of secondary material resources (SMR) by the following method.

Based on a classification of wastes (emissions) of the glass industry and an analysis of possible turnover of such SMR, we determined the following priority approaches:

— creation of low-waste technologies (pneumatic jet crushing or mixing the ingredients of the glass charge, its compaction in a roller press, etc.);
— use of SMR as raw components of the charge (secondary processing of industrial and household waste glass into powder or granules, and technological solutions and slimes from dust and gas cleaning systems, etc.); additional cleaning of residual waste;
— use of SMR as a raw material for new structural, building, and varnishing materials;

These principles were realized on the basis of a block and module method that allowed us to combine them into a single ecologically safe industrial complex with minimum expenditure and minimum consumption of power and resources. The newly designed apparatuses, devices, and highly efficient technologies for dosing, stirring, mixing-and-crushing, compacting, glass melting, waste processing, and gas cleaning were subjected to comprehensive testing and have been installed in a few enterprises.

For example, the dust content and thermal volatilization of the charge and molten glass components in charge preparation and glass melting shops have been reduced due to

— the use of compacted charges in the form of plates having a high density and strength; the special shape of the product makes it possible to heat the charge with effluent gases before melting, decrease its melting temperature, and markedly decrease harmful emissions into the atmosphere; appropriate equipment (roller presses) and technologies have been developed for all types of glass;
— installation of airtight vibrating batchers (vibrating gates) which provides for controlled consumption of the charge components and dust caught in the gas cleaning unit;
the use of devices for dry gas cleaning provides for a marked decrease in the content of harmful dust and gas emissions within the work zone and into the atmosphere.

The suggested engineering solutions for utilization of solid and liquid waste make it possible to use it for a second time in the production of glass and to prepare new materials and articles for the medical, paint and varnish, chemical, illumination engineering, mechanical engineering, building, and other industries.

The developed methods and equipment for secondary processing of solid glass fiber waste and conventional glass scrap by the methods of thermogranulation and self-grinding give glass granules 3–6 mm in size and microscopic balls (hollow and solid) 5–200 μm in size. These are used as a raw material for glass melting and preparation of enamels and frits, as a very effective filler for thermosetting plastics, for jet abrasive treatment of metals, production of anti-burn and resuscitation beds for hospitals, and in other fields. Modern effective compositions of anti-corrosion coatings for cars and chemical equipment, water-dispersed paints, and undercoats have been developed. The range of colors and color combinations for facing tile is virtually unlimited.

Liquid waste from the main production is commonly utilized as a secondary material. The problem of processing water emulsions of lubricants for glass fiber, aqueous solutions of sulfuric and other acids used in polishing crystal articles, and waste water from dust and gas catchers has been solved successfully.

The multiple requirements imposed on processes and devices for continuous proportioning of charge ingredients have led to the appearance of various designs. This was caused by the differences in the granulometric compositions and other structural-mechanical and physicochemical parameters of the investigated materials. The basic criteria for choosing the design is the accuracy of proportioning, reliability, simplicity of structure, and convenience of operation. A very interesting variant is the use of large-volume vibrating batchers that promote the creation of ecologically safe, resource-saving technologies with an elevated level of labor safety and productivity. The problems to be solved in the field of continuous proportioning consist in extracting the material from bunkers, weighing it, and controlling the output and metrological characteristics.

The accuracy of batching is ensured by design factors and steady flow of friable materials. The latter is provided by an additional power action (vibration energy) whose mechanism differs from the known engineering solutions used, for example, in the batchers produced by Wand T. Avery Ltd. (Great Britain). The principle is used in the gateless electromagnetic vibrating (noiseless) feeders developed. Proportioners and gates have been designed (by analogy with the known “flickers”) for various purposes in various sizes (Figs. 1 and 2).

An analysis of the mixing process with respect to two parameters, i.e., homogeneity and activity, shows that pneumatic jet mixers (Fig. 3) have good prospects. A physical model has been suggested for the process, which consists in the effects of disintegration and abrasion of lower-hardness charge ingredients by high-hardness ingredients. This phenomenon is the basis of power-consuming and wasteless methods of charge mixing accompanied by disintegration of...