

## ABSORPTION-BIOCHEMICAL UNITS (ABChU) FOR VENTILATING AIR PURIFICATION IN FOUNDRY

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Clean air is one of the essential conditions for high-efficient labor and human health.

In the core molding and die casting processes (Fig. 1) with subsequent cooling and shaking out a wide range of gaseous substances of the second, third and fourth hazard categories, including phenol, formaldehyde, furfural, methanol, ammonia, acraldehyde, cyanides, benzapyrene, triethylamine, diethylamine, xylene, toluene and a number of hydrocarbons, vents into the atmosphere with ventilating air. This is the cause of an offensive odor and exceedence of the hazardous substance maximum allowable concentration in the atmospheric ground layer of residential areas adjacent to the foundries.

Volumes of vented emissions from the foundries and shops are from several tens of thousands to several million cubic meters per day and harmful substances emissions are tens and hundreds of tons per year.

The researchers from the Belarusian National Technical University had developed a technical process and a design of units for absorption and biochemical purification of vented air from harmful organic substances (Fig. 2).



Figure 1 – Mold casting

Ventilating air purification with the ABChU is based on natural processes:

- the first principle lies in the fact that the majority of harmful volatile organic compounds are soluble in service water;

- the second principle is based on the ability of specially selected and adapted microorganisms to use dissolved organic and some inorganic substances in water as replenishment source. In the process of these compounds consumption by microorganisms their complete mineralization occurs with formation of water and carbon dioxide.

Harmful substances are trapped with the help of water absorbent in the scrubber with a movable ball-type packing and are neutralized in the bioreactor. Microorganisms in the form of concentrated biomass are added into the bioreactor once before the unit operation commencement. The solution circulation in a closed “scrubber–bioreactor” cycle prevents industrial drains.

The Gazoochistka Engineering LLC develops and manufactures ABChU [1] with a ventilating capacity of 5, 10, 15, 20, 25, 30 thousand m<sup>3</sup> per hour (Fig. 3).

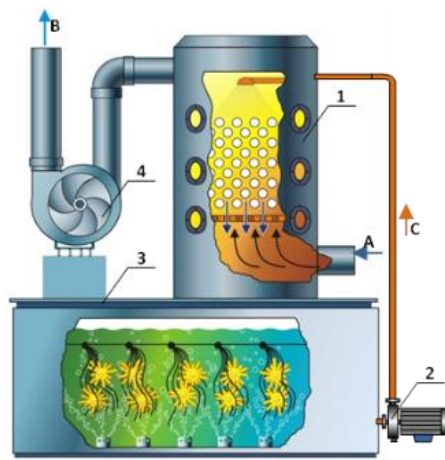


Figure 2 – Diagram of the ABChU:

1 – scrubber with mass exchange grids and packing; 2 – pump; 3 – bioreactor with packing and aerators; 4 – fan; A and B – ventilating air input and output; C – absorption solution

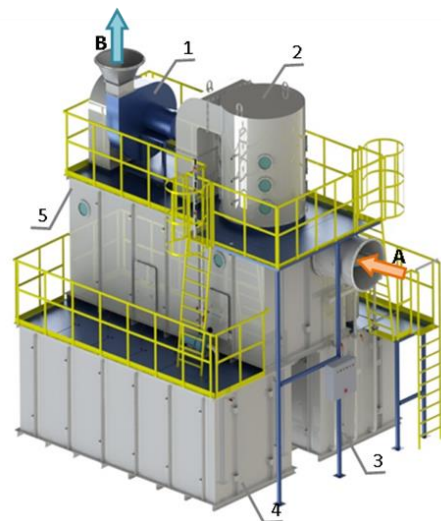


Figure 3 – General layout of the ABChU with a ventilating capacity of 20,000 m<sup>3</sup> per hour.

1 – fan; 2 – scrubber; 3 – sludge chamber; 4 – bioreactor; 5 – drop separator; A and B – ventilating air input and output relevantly.

Condensation of aerosols and vapors of high-boiling substances as well as surface-active substances (surfactants), which are produced under microorganisms' life activity, contributes to the increase in efficiency of water absorption of hardly soluble substances. The surfactants presence is indicated by the foaming in the system of water absorbent regeneration [2].

The nominal characteristics of the harmful impurities separation efficiency remain throughout the whole unit service life and are, as a rule, 90-99%.

Twenty-year experience of the ABChU operation at 52 enterprises of Russia, Belarus and Ukraine showed that upon aggregate index: functionality, efficiency, environmental compatibility, reliability and operation simplicity – the absorption and biochemical technology is the optimal and other times the only technical solution for purification of the air-gas complex compounds (multicomponent, high temperature, presence of suspended, resinous and condensation substances).

Thus, for example, 1) on application of the "dry" methods (coals, catalysts, ion exchange fibers, ozonizers) for the abovementioned purposes, the purification functionality is sharply reduced due to filter working surfaces overgrowing by deposits; 2) in the course of core molding under Cold-box-amin process an increasing number of enterprises prefer to neutralize amines not in "acid" scrubbers but apply the ABChU with significant economic and environmental benefits.

Several ABChU are applied with a total ventilating capacity of 25-30 thousand m<sup>3</sup> per hour in case of necessity to purify large volumes of vened air (Fig. 4).



*Figure 4 – The gas cleaning complex of four ABChUs with a total ventilating capacity of 100,000 m<sup>3</sup> per hour*

#### **Summary:**

1. The absorption and biochemical technology for harmful organic substances neutralization compare favourably by capital and operating costs with other methods of cleaning. This technology is tested under various conditions and could be recommended for usage in foundries.
2. The ABChU installations are especially effective in vented air purification at casting, cooling and knockout of molds.
3. Vented air purification with the ABChU reduce harmful substances emission into the atmosphere and also diminish odor effect significantly in the area of foundry location.

#### **References**

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