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ENGINEERING SOLUTIONS FOR TEMPERATURE CONTROL SYSTEM OF BIOREACTOR FOR MICROBIAL PESTICIDES MANUFACTURING

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A topical issue for fermenter-sterilizers is the fast and effective cooling of the nutrient liquid medium after thermal sterilization. Simple chilling of medium in bioreactor vessel could take from several hours to a day corresponding to vessel volume. Forced cooling typically requires significant energy consumption.

This problem is particularly acute for pilot-scale bioreactors with a capacity of 100–500 l, which are the most common equipment used for the microbial pesticides manufacturing at small biofactories in Ukraine and other Eastern European countries. Such facilities usually do not have a separate heating and cooling system typical for microbiological industry. However, the volume of bioreactor's vessel requires the medium chilling with significant time losses even in combination with air cooling system in fermentation room, whilst passing tap water through the reactor jacket is extremely costly.

One way to solve this problem involves energy-efficient methods of liquid cooling by dry coolers. Such engineering solution was applied to optimize the temperature control system of the AF-0.170 self-contained bioreactor (ETI "Biotekhnika" NAAS) with 130 l working volume.

The AF-0.170 self-contained bioreactor is a fermenter-sterilizer with agitation and aeration systems. The bioreactor is equipped with a water jacket to ensure temperature control of the medium during thermal sterilization and the microorganism cultivation. There was a solution to use external cooling circuit with a dry cooler for bioreactor temperature control system optimization. The optimized temperature control system, in addition to the heat exchanger (the dry cooler) includes a wet-rotor pump and an automatic control system.

Calculations show that, compared to other methods of cooling of thermal sterilized medium, a dry cooler has a number of advantages:

– low operating costs;
– complete isolation of the system from the main bioreactor devices;
– heat recovery for fermentation room heating;
– the ability to use the system intermittently during the winter months;
– minimal support.

There was produced a prototype of cooling circuit with a capacity of 5 kW/h at ETI "Biotekhnika" NAAS. The cooling circuit control system is fully automated and features a separate control panel. Cooling of the medium after sterilization takes up to 6 hours to reach inoculation temperature (27–30 °C), which is 3–4 times faster than simple chilling in the reactor vessel. The cooling circuit can also be used while microorganism cultivation stage.

The optimized temperature control system of the self-contained bioreactor significantly reduces the duration of the pre-fermentation stage of microbial pesticides manufacturing and lowers operating costs.

Keywords: bioreactor, microbial pesticides, nutrient medium, dry cooler, temperature control

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