2ND WORKSHOP ON APPLIED AND SUSTAINABLE ENGINEERING

STUDY OF THE FREEZING PROCESS OF THE FISH BLOCKS WITH USING OF ALUMINIUM FOIL SPACERS

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SUMMARY

Freezing is currently the most common method of food preservation. Reducing of the freezing time is very important. It is also particularly important to shorten phase change time (water to ice). It has an impact on a improving of the quality of frozen food and on the process energy consumption.

The article presents the study of the influence of aluminium foil spacers inside the fish blocks for the freezing process. The influence of the spacers thickness on freezing process kinetics was found. It was found that the use of aluminium foil spacers reduced the total freezing time about 30% and the phase change time about 40% in relation to those total times obtained for blocks without any spacers.

INTRODUCTION

The aim was to show the influence of aluminium foil spacers of different thicknesses placed inside the frozen fish blocks on time of the phase change (water in ice) and total time of freezing. The research material was blocks composed of sprat Baltic. The frozen blocks had dimensions: 160 x 120 x 55 mm. Aluminum foil spacers were placed iside the bloks (Fig. 2 and Fig. 3). They were in three thicknesses: 0,08 mm, 0,16 mm and 0,4 mm. Freezing was done in a special chamber (Fig.1) under natural convection of air at a temperature of – 22 °C. During freezing, temperature changes were recorded at the center of the block. Temperature measurement was performed using K-thermocouples in the witch a thickness of 0,5 mm fiber braided (T_{max} = 400 °C). The signal from the thermocouple was transmitted to the measuring card PCI 1710HG installed in PC computer. The measuring card was supported by the LabView program that allows recording of the measured temperature. Visualization of results was performed using Matlab.

Total freezing time is defined as (Fig. 3)

$$\tau_c = \tau_{ch} + \tau_z + \tau_d$$

where:

τ_c - total freezing time, τ_{ch} - cooling time, τ_z - freezing time (change phase – water in ice), τ_d - additional freezing time.

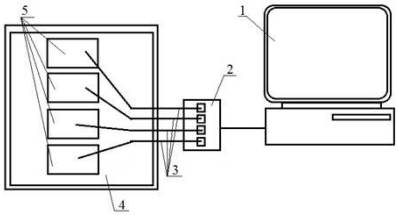

Fig. 1. Schematic diagram of the test stand. 1 - computer with the measuring card, 2 - adapter terminal, 3 - K- thermocouples, 4 - freezer chamber, 5 - frozen fish blocks

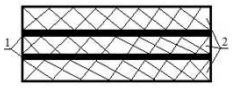

Fig. 2. Diagram of a cross section of the frozen fish block. 1 - aluminum spacer, 2 - layer of fish

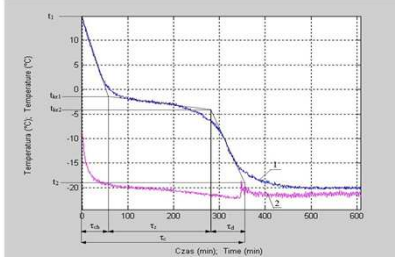

Fig. 3. Temperature changes in the center of the block during freezing in the air with the labeled process phases

Fig. 4. Photo of the freezer chamber

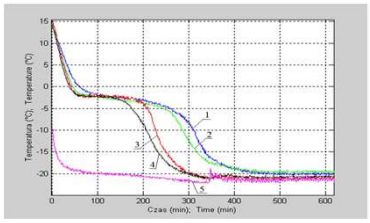

Fig. 5. Freezing curves: 1 – without spacers, 2 – with 0,08 mm spacers, 3 - with 0,16 mm spacers, 4 - with 0,40 mm spacers 5 – air temperature

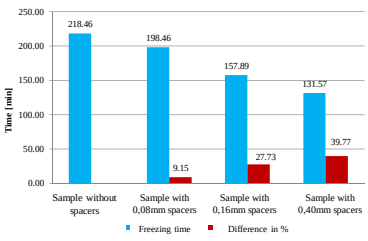

Fig. 6. Comparison of freezing time (change phase – water in ice) for fish blocks with aluminum foil spacers of different thicknesses

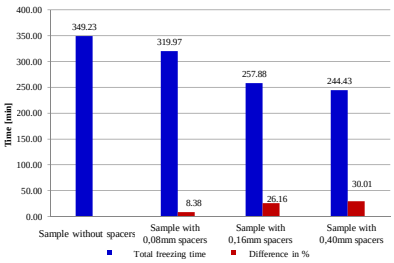

Fig. 7. Comparison of total freezing time for fish blocks with aluminum foil spacers of different thicknesses

CONCLUSION

The use of aluminum foil spacers reduced the total freezing time. For a block with 0.4 mm thick spacers, the total freezing time was reduced by 30% compared to the block without spacers.

The placement of aluminum foil spacers inside the fish blocks influenced a shortening of the times of individual freezing phases:

- for cooling phase about 28%,
- for freezing phase about 40%,
- for additional freezing phase about 2%.

LITERATURE

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