THERMAL LOSSES IN THE DIELECTRIC CASE OF THE ABSORBING LOAD OF LIQUID CALORIMETER IN MEASURING THE ENERGY OF HIGH-POWER MICROWAVE PULSES

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Liquid calorimeters are successfully used to measure the energy of high-power microwave pulses [1]. The energy of the pulses is determined by measuring the increase in the volume of the working fluid based on ethyl alcohol, filling the volume of the absorbing load. An advantageous feature of these devices is their calibration, which is performed by applying an electrical pulse to an active load (calibration heater) located in the volume of the working fluid. An analysis of the thermal processes associated with the calibration of the calorimeters was carried out in [2]. The process of absorption of microwave pulse energy in the working fluid may be accompanied by the loss of part of the heat into the dielectric housing of the absorbing load and, thus, the underestimation of the measured energy. This work is devoted to the analysis of this undesirable effect. Using the results of solving the well-known problem of half-space cooling [3] in a flat approximation (Figure 1) without taking into account convection, analytical estimates of the heating of the polyethylene case of the absorbing load of the calorimeter were made.

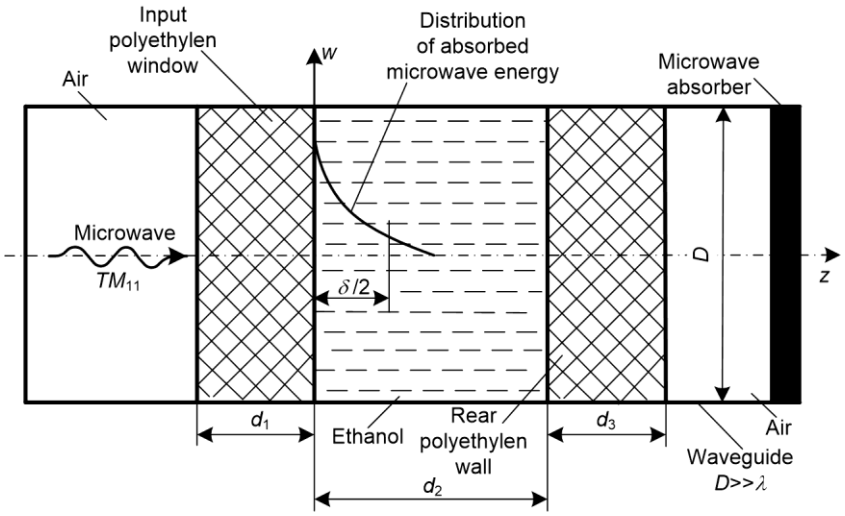

Fig. 1. Computational geometry of the problem.

The estimates show that the fraction of heat transferred from the alcohol to the dielectric increases with an increase in the carrier frequency of the microwave pulse and the duration of the measurement procedure. In the less favorable case, when the measurements are performed in the X-band, and the microwave energy is released mainly near the dielectric, the estimate of the underestimation of the measured microwave energy can reach tens of percent during the measurement time of 10 s. These results differ markedly from the experimental data. In order to more fully take into account the effects of heat transfer and more accurately determine the possible underestimation of the calorimeter readings, numerical simulations were performed.

REFERENCES

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