Chapter 7
To Methodology Research of Microwave: Convective Processing of Frain

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ABSTRACT

In the presented materials, a system of principles and approaches for studying processes of microwave-convective grain treatment is discussed. The essence of this research is described starting from the initial phase of designing structural diagrams of technological processes. Based on the explicitly-defined process target, a functional-physical analysis has been performed that made it possible to specify the most essential factors of process. The morphological analysis of the processes was carried out in several stages. At each stage, the specification of the goal and excluded variants of factors that at this stage, the development is impractical to implement. It is advisable to carry out a check of the effectiveness of the options selected from the morphological table using modeling. To this end, developed a mathematical and computer models of the process. The results of modeling the drying of grain in the microwave - convective zone confirmed the feasibility and efficiency of using the obtained model.

DOI: 10.4018/978-1-7998-1216-6.ch007

INTRODUCTION

In technological processes of grain post-harvest handling, those involving thermal treatment belong to leaders, in terms of energy consumption. However, it is impossible to avoid these processes since they are commonly applied in grain drying and sanitation techniques. That is why reduction of energy intensity of these processes is a problem of prime importance.

Application of microwave electromagnetic fields is regarded as one of the effective methods for energy consumption reduction in grain drying and sanitation technologies, in which case grain dielectric properties are employed for its heating. It makes it possible to avoid energy loss associated with heat consumed by heat-carrier and removed from a technological cycle. In case of grain convective drying, gradients of temperature and moisture content are oppositely directional, within grain seeds, which adversely affects process effectiveness. When microwave heating is used internal layers of seeds are heated to higher temperatures owing to their higher moisture content. Therefore, gradients of moisture content and temperature are unidirectional. That is why energy consumption for grain drying is lower compared to conventional convective drying techniques (Ospanov, Vasilyev et al., 2017; Budnikov, & Vasiliev, 2018).

Studies in the field of microwave technologies application in grain postharvest handling, particularly for grain drying, have been carried out for many years (Horynski, 1999; Kupfer, 1999; Barbosa-Canovas, et.al. 2001; Jumah, Raghavan, 2001). Nevertheless, implementation of these technologies in agricultural production has not yet gained desirable scales. It can be explained by the need to employ more complicated equipment compared to conventional convective drying methods. But, in a greater degree, it is associated with the absence of required nomenclature of reliable equipment and machinery. However, such machinery can not be designed without detailed and comprehensive study of convective heat-and-moisture exchange processes in grain layer under the effect of microwave fields. For this purpose, an adequate research methodology has to be developed.

RESEARCH METHOD

Methodology, in its practical sense, is a system of principles and approaches for research activities that have to be adhered by researchers in the course of obtaining and development of knowledge, in the frames of a specified problem (Novikov, & Novikov, 2013; Lukashevich, 2001, Ruzavin, 1975). The following system of principles and operation sequence was applied in the course of studying the process of microwave-convective treatment of grain:

1. Development of process block diagram.
2. Development of the target statement for technological process.
3. Defining controlled parameters, control actions, initial conditions and status options for the object under control.
4. Application of functional-physical analysis to controlled parameters, control actions, initial conditions and status options of the controlled object.
5. Morphological analysis of the process under development and selection of appropriate variants of initial conditions, controlled parameters and control actions. Adjusting the purpose of the process.
6. Development of mathematical model for the process under study.