Cost Optimization and Modelling in Autoclaving

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Abstract: My examinations aimed at the positive role of software production programming on costs. In addition to the fact that reduction of expenses can be reached with rearrangement of production between shifts, I pointed out that with this simulation technique the following problems can be avoided: product bump on the production belt due to careless planning, product piling in the heat-treatment unit and thus, product deterioration due to the heat-treatment which was not started in time. To put the experiences in practice I developed a software system based on factory data. In development I used Microsoft Excel and Access programs as software environments and I made the necessary program codes in the built-in Visual Basic for Applications, as a programming language. I elaborated a user-friendly operation mode to reach functions with a special menu. Queries can be applied to check product bump on the production belt and sufficiency of heat-treatment capacity.

Keywords: Modelling, Cost Optimization, Autoclaving

1 Introduction

To increase quality is the primary aspect in food industrial researches. It is the most important aim to lessen the degree of conservation in food processing otherwise the food cannot preserve its original qualities, consuming and nutritional values. Furthermore, consumers claim the possibility to prepare their food more quickly, the safe and hygienic application, longer shelf-life, the constant and checked quality, the usability on wider scale and the solution of unexpected situations. All of them could be utilized by preserved food-makers but for this they have to employ modern work organization which follows the expectations of our time [1], [2], [3], [4], [5].

Heat-treatment is used to prevent the microbiological danger thus it makes longer conservation-time possible. However, in case of an over-guaranteed heat-treatment there is a deterioration of quality, since sensory features, substance, taste, smell of the food can suffer a serious loss (discolouration on the surface in

case of liver pastes, liquid exudation and jelly precipitation in case of meat, transformation into puree etc.)

It is worth involving engineering calculations, modelling, computer simulation in the research of this field, for the sake of the quality of products and expense-efficient production. A work organization should be formed which guarantees manufacture of products which are safe from microbiologal aspect; which keeps the regulations more precisely in the interest of higher quality and lower expenses. To do this there should be an informatic background which can provide the necessary assistance, on the basis of research results, to elaborate the suitable work organization. For this aim it provides the user-friendly operation surfaces, which fulfill the claims of our time, the simulating and optimizing technique, the predicting and problem solving services and the flexible enlargement possibilities.

2 The plan of the software system

Since our program involves a simulator, it is advisable to complement it with components which support the model parameters again. Thus, the program will be suitable to check the model periodically and it guarantees that other companies can adapt it easily.

2.1 Software environment

A database manageable with an Excel spreadsheet would serve the user's interest the most. Thus, data processing and tabulation, graph making, which fit to the different demands and cannot be planned in advance, could be done easily. Application of spreadsheet guarantees a simple opportunity to provide program functions for calculations and graph making, besides it can be used as a development environment with the service Visual Basics for Applications (VBA) to elaborate the program. In addition, the database manager program should be used because firstly, it is easier to realize data storage, secondly, the program could have more functions, thirdly, the user-friendly way of data entry can be guaranteed by the technique of forms. Fortunately, both the spreadsheet and database manager can be applied since Excel sheets can be used as attached tables with the database manager program. It means that physically the data storage is realized on Excel sheets, while Access manages these data as if they were stored in its own tables. Thus, data correction done in Access will be stored on Excel sheets.

2.2 User interfaces, main functions

After starting the program the first thing to appear is the main menu (Figure 1) which shows three submenus, besides log out. If we choose „Data input, modification", we can find the points shown by Figure 2.

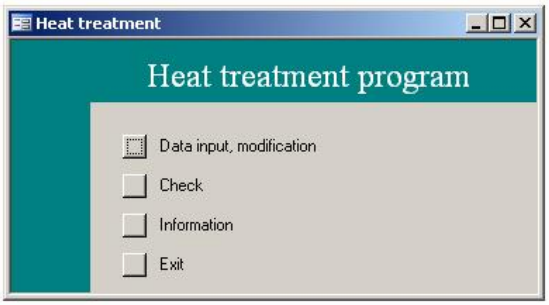

Figure 1
The main menu of Access

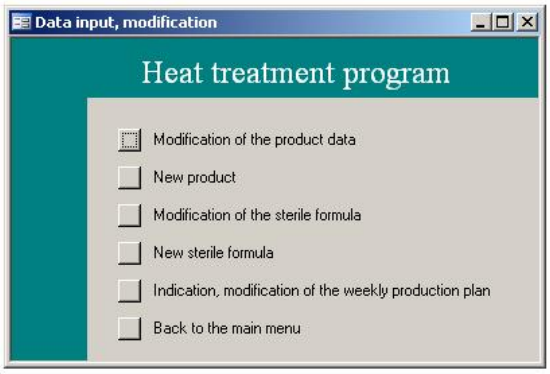

Figure 2
The submenu of „Data input, modification"

First of all, we can fix the data of tables „Product" and „Sterile formula" which can be modified only when a new product is to be manufactured or the regulations on the heat-treatment (sterile formula) of a given product should be modified because of the bigger security or the earlier over-guaranteed regulations. The user will rarely need these functions, the program provides forms of data input to realize them.

Indication of the data of the weekly production plan is used in a weekly frequency in the program which can be done by means of a form (Figure 3).

Figure 3
Form of indication and modification of the weekly production plan

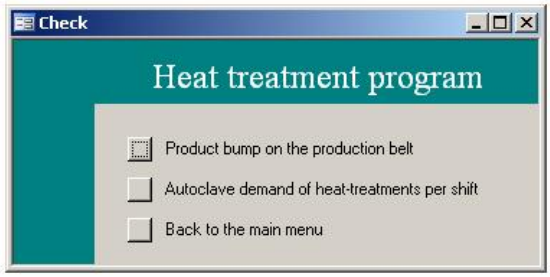

Figure 4
„Check" submenu

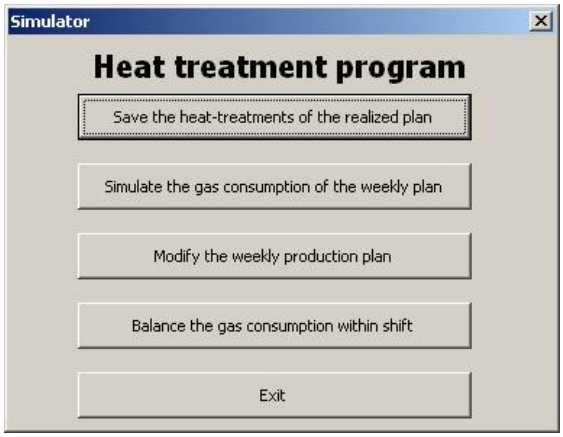

Figure 5
The main menu of Excel

Due to the applied technique of attachment, data manipulations done in Access forms are stored on Excel sheets, so they can be used directly in Excel.

Data of the plan should be checked. The submenu „Check" guarantees these functions (Figure 4). The first one examines if the plan contains a mistake in case of which more products would arrive at one production belt at the same time (in the same shift). The list of products bumping on the production belts are provided by a query available on the Access surface which is shown by the program as the view print preview by means of a report. Since the table stores, among the product data, which production belt it can be made on, this result can be obtained without simulation.

The other checking function examines if the heat-treatments can be done in time. We can get the printable report without simulation, since the number of the necessary autoclaves can be calculated from the time spans of heat-treament stored in tables. If the demand of any shifts exceeded the capacity, the plan should be modified. For this, the list shows when the capacity is unemployed in the suitable measure and then we can move the product here with the form which modifies the plan.

Having the checked plan the Excel spreadsheet takes over the work from the Access database manager to do the other tasks. It is the main menu shown in Fugure 5 which helps us reach the functions that should be performed in the order of appearance with weekly frequency.

First, we can save heat-treatments of the realized weekly plan, then we can simulate gas consumption of the plan for the following week. Then, the program generates heat-treatment data necessary for the input of the simulator, and makes the calculated data for gas consumption broken down in shifts appear on a diagram. Data generation is done with a VBA (Visual Basic for Applications) operation, while the program switch on the adequate sheet to make the diagram appear. The task of this function is to point out if it is necessary to modify the plan, provided gas consumption of each shift shows a big deviation. The manual data modification can be accomplished with a form made for data input, but plan modification can be done automatically, too, in case of which a VBA operation rearranges the products of the plan within shifts. Modification can be followed by the user in a table of a sheet, and then it can be printed, too.

The last function of the program guarantees that gas consumption within the given shift will be even, evolving the appropriate schedule by delaying the heat-treatment of the products. It is done by a VBA algorithm, together with the simulator, which in every shift of the production week tries to find the value variation of delay of heat-treatments which causes the gas consumption of the lowest standard deviation thus securing the even boiler-load and avoidance of high gas consumption peaks. In this function the maximum waiting time appears as a restriction since it cannot be exceeded to avoid spoilage of canned food. As a final result we can get the optimal value variation of the waiting time for the heat-treatment which then gives the recommended time to start heat-treatments.

Apart from the initial setting functions, the program should be used in a weekly frequency and by storing the data of the accomplished heat-treatments, it makes their registration possible. This registration is compulsory for the company but the stored data can provide an excellent basis for an informational system, too. In our database statements can be made with queries from different points of view, and our data can be displayed even in diagrams. We can easily observe changes, tendencies and seasonalities in the production profile. These functions can be formed in „Information" submenu. Thus, for example, we can have a statement on the weekly summary of production, a diagram of the changes in the produced amount of a certain product per week, production of a selected week per product etc.

Conclusions

For the software developed for simulation, optimization and sceduling the Excel can be applied, in a user-friendly way, to store, process the data and to represent them in diagrams, to fulfill programming tasks, while the Access to feed data into the computer with forms and to form queries and reports. The developed computer system guarantees an easy possibility for data input and modification, to check product piling on the production belt, to avoid the long waiting lines for the heat-treatment by checking the autoclave capacity, to balance the gas consumption of the shifts and to prevent the gas consumption peaks. All in all, it can guarantee the manufacture of better quality products with lower direct costs.

With this simulation software system the production process, which starts with the production belts and finishes with heat-treatment on the autoclave group, can be organized so that products of better quality can be manufactured assuring regulations on heat-treatment, while it guarantees lower direct costs avoiding product bumps on the production belt and long waiting lines before heat-treatment and balancing the boiler load both within and between shifts.

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