

DIPLOMA THESIS REVIEW

Thesis title: **DESIGN OF THE DRYER FOR LUMP SUGAR**

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Reviewer: **Doc. Ing. Iva Filková, CSc**

The diploma thesis consists of 80 pages, 46 figures, 14 tables, and 1 appendix. Seven steps (tasks) were submitted and recommended in order to get the aim of this work.

The thesis is written in English that is evidently not the mother tongue of the candidate. This is the reason of sometimes difficult understanding of some parts. Using different symbols for one quantity, e.g. moisture content, doesn't contribute to easy orientation, too. The work is divided into two main parts, *theoretical* and *experimental*, each consisting of three and four chapters, resp.

In *theoretical part*, the first chapter deals with the brief description of drying principles with particular respect to food drying. Moisture diffusivity, diffusion equation with analytical solution, and common mathematical models are discussed here. The importance of drying curves as the starting point for drying process calculation is also pointed out.

"Literature search" is the title of the second chapter. It is rather misleading since the first chapter and all following chapters are based on "literature search" as well. This search is devoted only to drying equipment specification, thus the title should better reflex it.

Explanation of computational fluid dynamics, CFD, its principles and its application to simulation of drying in food industry can be found in the third and last theoretical chapter. Here is also discussed the CFD simulation of heat and mass transfer analogy.

Four more chapters are presented in the *experimental part* of thesis. The fourth chapter, which is the first experimental one, describes the experimental equipment and set-up. It is the chamber dryer slightly modified in order to obtain drying curves of sugar cubes under different air temperatures and velocities. Resulting drying curves are shown in Fig. 17 to Fig. 28. The experimental data are compared with three selected mathematical models that best suited the results, see Fig. 31 to 36. The results which are not in so good agreement can be found in the Appendix A. Further calculation provides the data of effective diffusivities for sugar cubes which will be necessary in drying kinetics modelling.

Chapter five deals with two-dimensional CFD simulation of drying process in a similar 2D model of the experimental drying chamber. Results of both, laminar and turbulent flow regimes are shown in Fig. 42 to Fig. 45.

In the chapter six the analytical calculation of heat and mass transfer coefficients is carried out. The resulting data are compared with those of CFD simulation and with the experimental ones. Due to good agreement, all three methods can be used.

Design of the belt dryer is the title of the seventh and last chapter. Following data are presented as the final results for given material (sugar cubes) and given type of dryer (belt): consumption of drying air, corresponding consumption of heating steam, belt width, length, and velocity.

Note of reviewer regarding the final results

There is a problem with the meaning of the word design. In the field of engineering it should be distinguished between “basic design” and “detailed design” of an equipment or production line. It is not clear what kind of design is expected as the result of this work. The resulting data are not sufficient even for the basic design which should include besides belt dimensions the selection of proper type of belt dryer, the proper draft with all necessary dimensions, auxiliary equipment, piping for the inlet and outlet media, etc.

If the dimensions of the belt were the aim of this work, the title should be slightly changed. Supposing that this was the idea, the thesis fulfils the submission. The theoretical part is rather brief, however sufficient for the following calculation. The candidate accomplished the experiments and selected proper methods to get a good agreement of the results.

Questions for discussion

1. It is evident from the diagrams of drying curves that the initial weights of sugar cubes are different, as mentioned also on the page 38 – the average weight ranges from 144 to 150 g. But the moisture content was equal – 3%. What was the reason?
2. It is stated on page 55 that two values of diffusion coefficient $D_{AB} \times 10^{-8}$ in table 9 and $D_{AB} \times 10^{-9}$ in table 10, “are approximately in close trend”. There is a difference of one order!
3. Explain why on page 57 for the flow of air is $Re = 9551$ specified as laminar flow, and $Re = 716$ as turbulent. Also evident in Fig.44 and 45.

The formal errors, usually due to transcription or language problems, are not considered as important, and are not mentioned here. The candidate should be allowed to defend this thesis. I am suggesting to evaluate it:

B (very good)