



DESIGN OF MIXERS FOR CHEMICAL AND BIOCHEMICAL INDUSTRY

Y. Ibryamova^{1*}, D. Dobrudzhaliev¹, B. Ivanov²

¹Technical Faculty, University Prof. Dr. Assen Zlatarov, Burgas, Bulgaria.

²Institute of Chemical engineering, BAS, Sofia, Bulgaria.

ABSTRACT

This paper examines the design of mixers for the chemical and biochemical industry. Depending on the mixing phases mixers possess different construction features. The design of mixers includes technological and strength calculations of these sets, able to create stable emulsions and suspensions used as raw materials in a number of productions or as finished products intended for consumers. The calculation and sizing of these facilities are made by means of specific algorithms, which are carried out in peer-reviewed software products. The use of such software helps facilitate most calculations for various types of mixers: a liquid-liquid, solid-liquid and liquid-gas.

Key words: Mixers, design, chemical and biochemical industry.

INTRODUCTION

Suspensions and emulsions in raw-material flows are used in a number of chemical and biochemical processes. A number of finished products must also occur in a steady state for the purposes of their transport and use. Many of the products in the food-manufacturing industry must exist in such sound systems. That is why their obtaining is essential and is a major task for such productions. The mixers are the equipment, which is used for this purpose, being the outfit, inside which a mixture of different phases: liquid-liquid, solid-liquid and gas-liquid is carried out. The phases define the type of industrial mixers. The development of such sound systems depends on a number of factors such as the physical-chemical properties of the mixing components, temperature, pressure, the presence of surfactants, emulsifiers, coagulants, etc. Of particular importance are the conditions for the conduct of the process of mixing and mixer structures. The design of the mixers includes

technology and constructive strength calculations involving all the elements of the mixers. Computational procedures are carried out by strictly defined algorithms, which have provided a basis for recently developed software products. Simulators that fully automate the design process are increasingly used in engineering chemistry. They have huge databases with construction materials used for the various elements of mixers. The major advantages of these software products are the consistent design and visualization. The organized interface to usable Office applications and the creation of documentation of each option are extremely useful for the effective multi-variant design.

Design of mixers

The basic algorithm design

1. Review of the existing (developed) drafts of mixers.

Figure 1 presents a list pane (automatically prepared) with already implemented projects of mixers. The examination and presentation of an already completed project provides an opportunity for increasing the designer's skill and saves time in the development of such a project.

*Correspondence to: *Yunzile Ibryamova, Technical faculty, University Prof. Dr. Assen Zlatarov, Prof. Yakimov Str. 1, 8000, Burgas, Bulgaria., Phone: 0894301679, E-mail: unzile_20@abv.bg*

2. Specifying the name of the Project-**Figure. 2.**

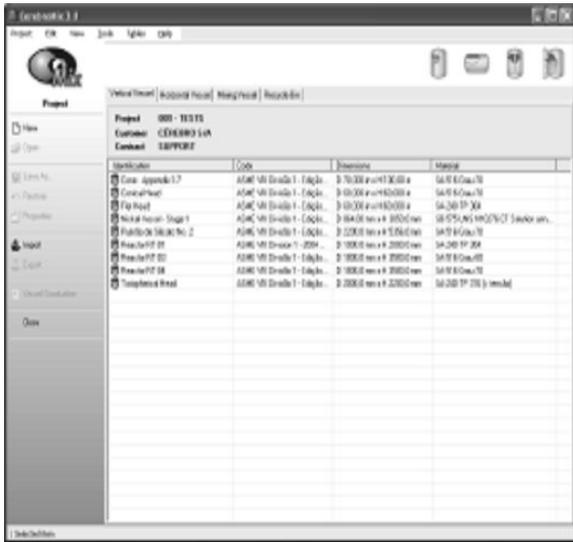


Figure 1. List of developed projects.



Figure 2. Starting a new project, specifying the name of the project.

3. Calculating a new mixer.

3. 1. Setting the geometrical characteristics (height, diameter) and choosing the type of

bottom and top of the apparatus-**Figure. 3** and **Figure. 4,** **Figure. 5.**

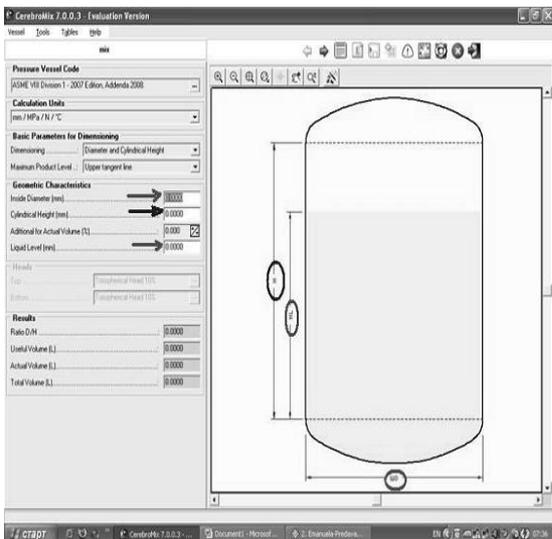


Figure 3. Geometric characteristics (cylindrical height).

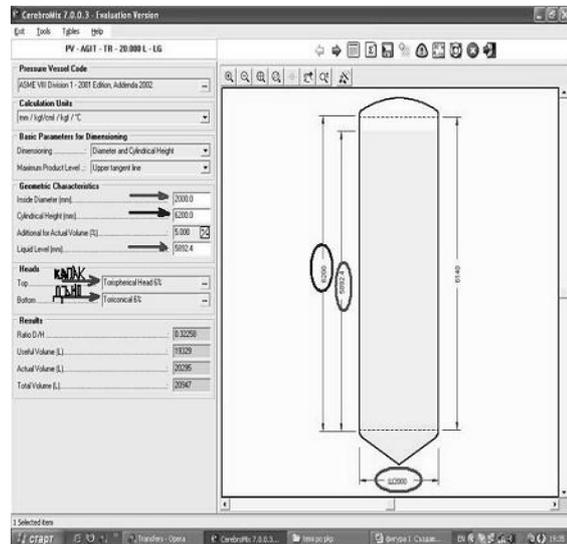


Figure 4. Geometric characteristics (inside diameter).

3. 2. Choosing the construction materials for the court, the top and the bottom (Selected from the database menu)-**Figure. 6.**

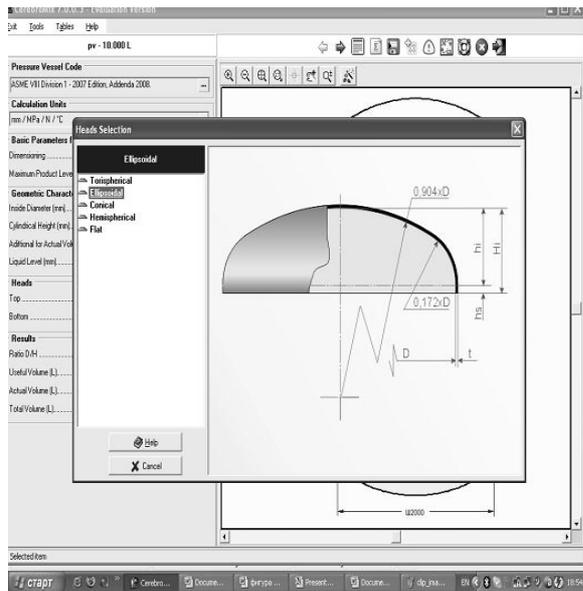


Figure 5. Torispherical head 10 %.

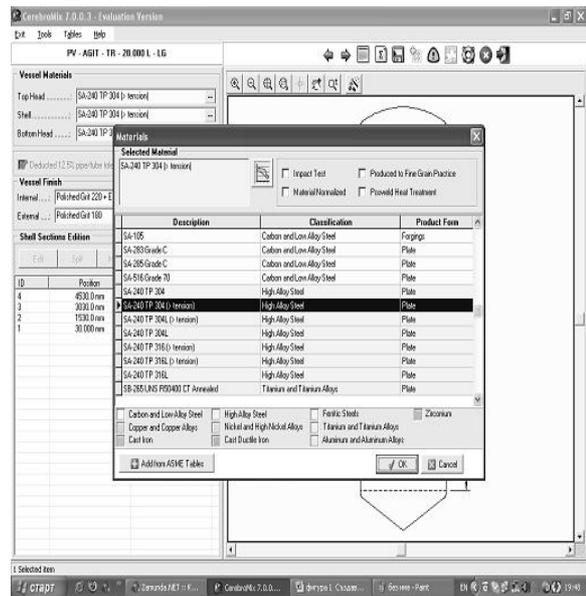


Figure 6. Choosing the materials.

3. 3. Setting the type of the mixed components, physical-chemical properties of fluids, thermodynamic parameters of the mixing

process and calculating the thickness of the hull, the top and the bottom-**Figure. 7** and **Figure. 8**.

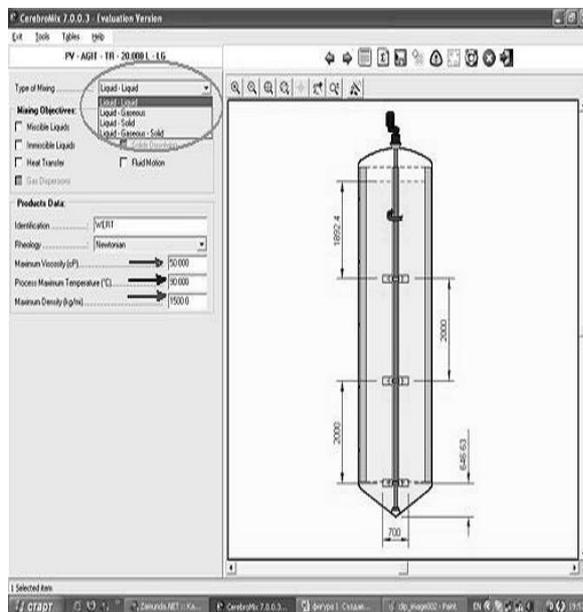


Figure 7. Calculating the sides of the hull.

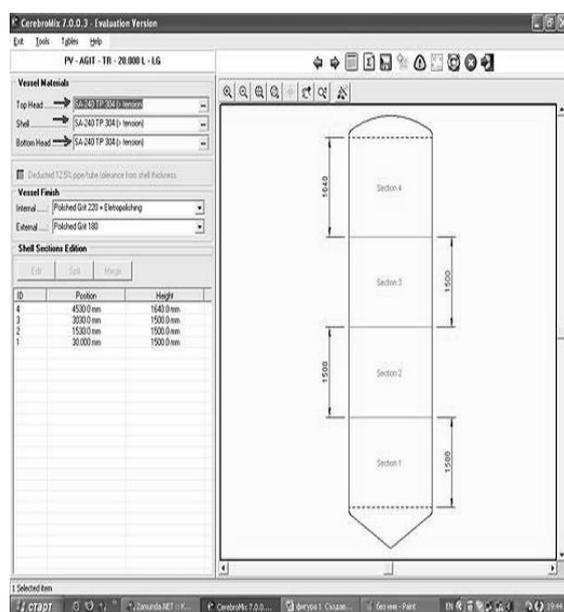


Figure 8. Resizing the body elements.

3. 4. Sizing of structural strength and welds, calculating the nozzles and methods for

securing and strengthening the apparatus to hull-**Figure. 9** and **Figure. 10**.

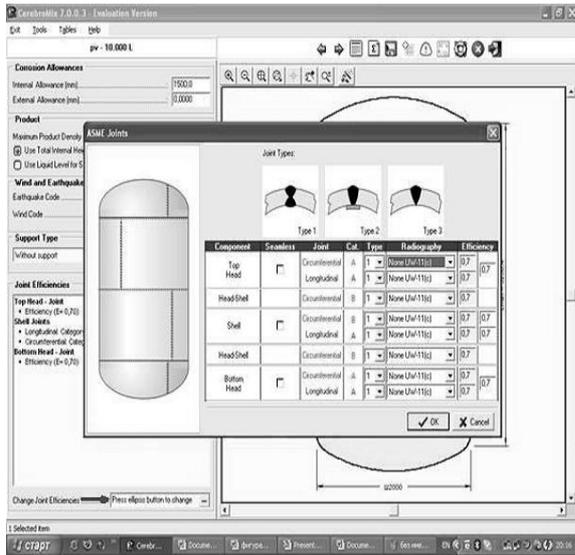


Figure 9. Welds.

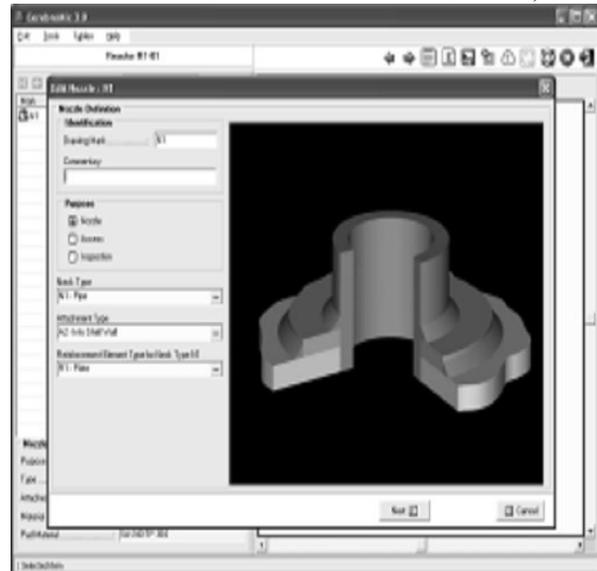


Figure 10. Calculating the nozzles.

3. 5. Setting the quantity of impellers-**Figure. 11** and **Figure. 12.**

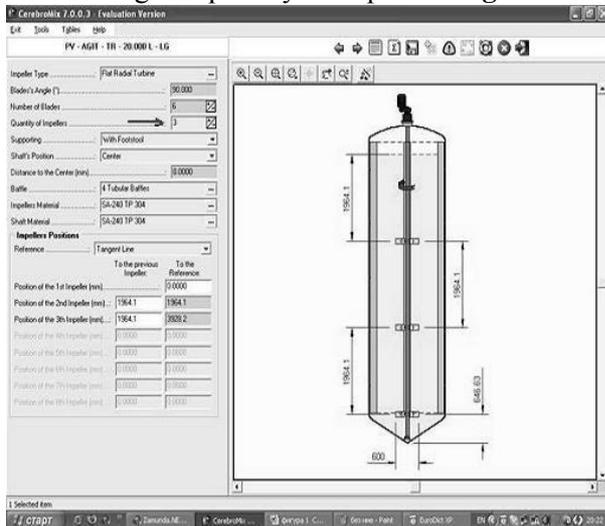


Figure 11. Quantity of impellers.

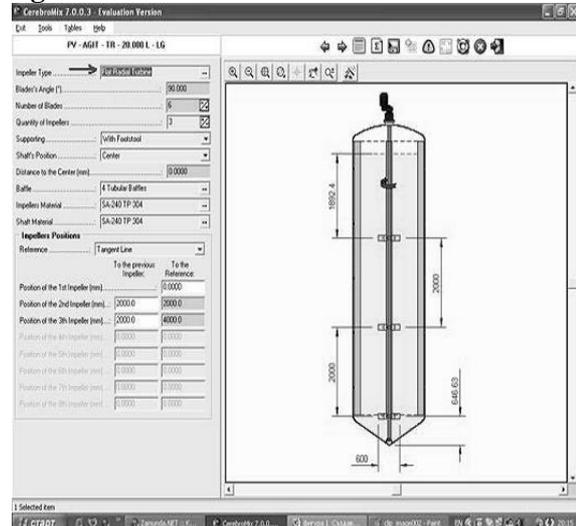


Figure 12. Impeller type.

3. 6. Setting the impeller type-**Figure. 13** and **Figure. 14.**

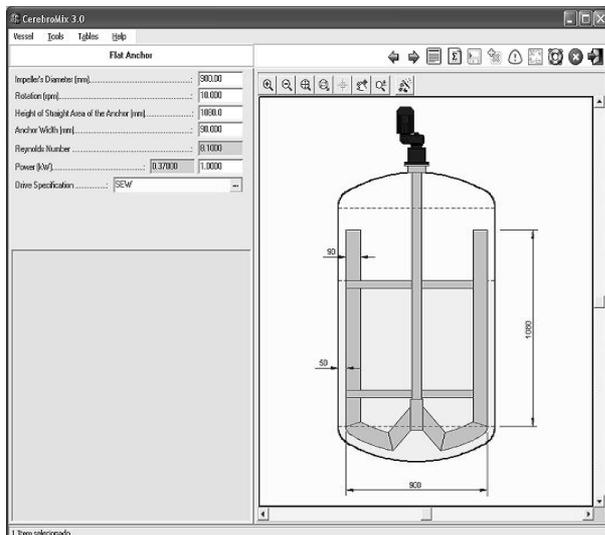


Figure 13. Flat Anchor.

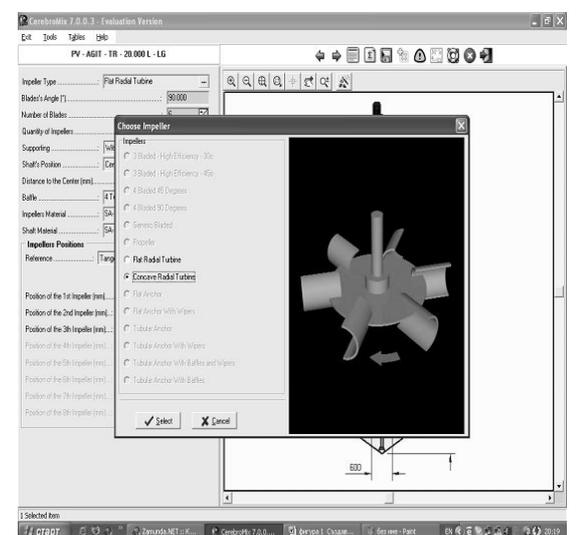


Figure 14. Concave Radial Turbine.

3. 7. Shaft's position-**Figure. 15** and **Figure. 16.**

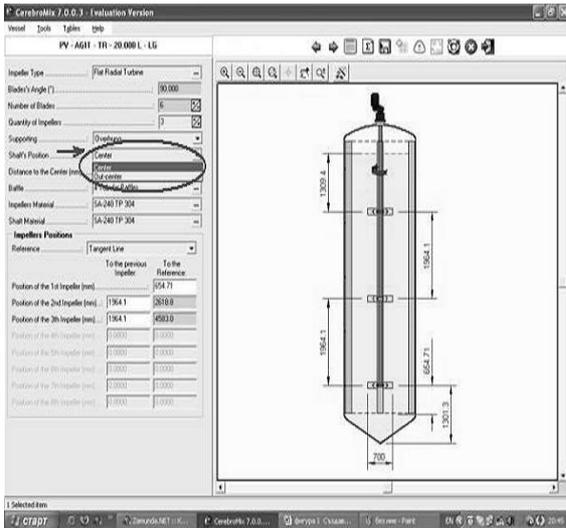


Figure 15. Center.

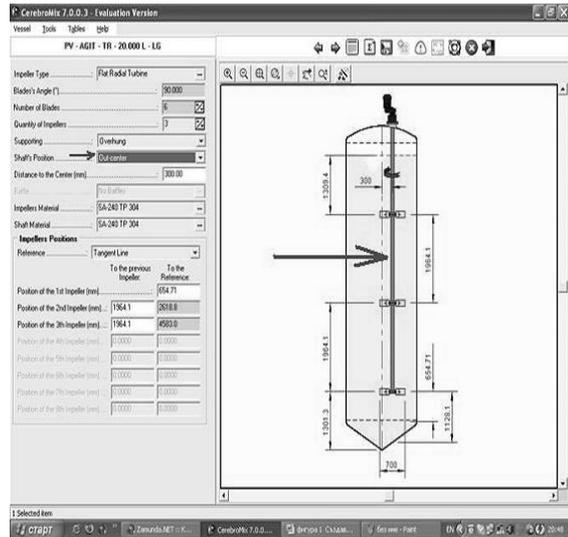


Figure 16. Out center.

3. 8. Supporting-**Figure. 17** and **Figure. 18.**

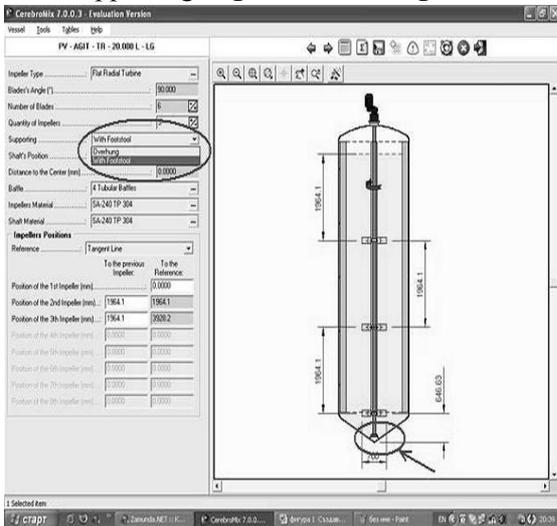


Figure 17. With footstool.

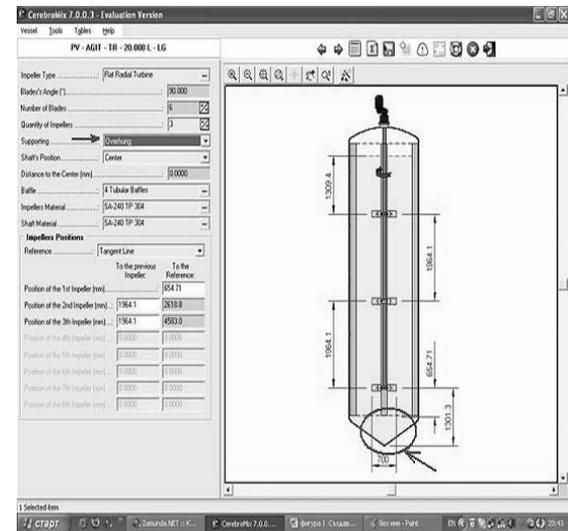


Figure 18. Overhung.

3. 9. Calculating and sizing the anchorage on the fundamentals-**Figure. 19** and **Figure. 20.**

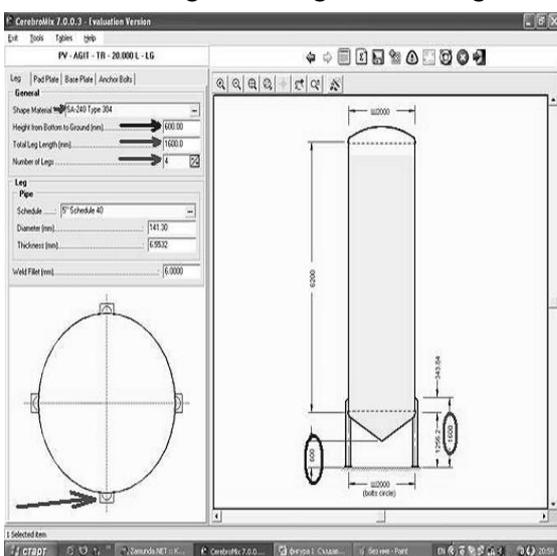


Figure 19. Calculating the legs.

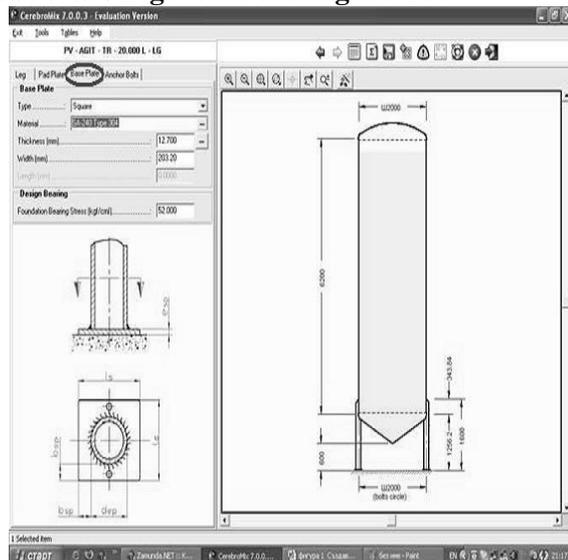


Figure 20. Sizing the attachment.

INTERFACE

In advanced software systems for design and simulation a friendly interface is organized together with the constructor, which facilitates the dialogue with the computer system. If necessary, the user can consult the special literature and manuals, finding the necessary data, which are missing in the electronic databases. Also, interfaces with applications developed as modules in different programming environments (VISUAL BASEC JAVA, etc.), are organized, thus increasing the effectiveness of the designer's work. In addition, interfaces to other Office

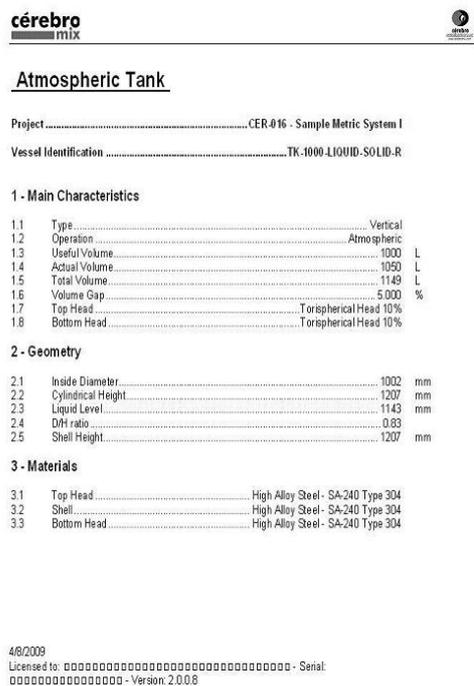


Figure 21. Home page.

CONCLUSIONS

The design of mixers for chemical and biochemical industry is a responsible and demanding engineering activity, which requires considerable experience. The use of automated design tools-specialized software or simulation-CAD systems increases the efficiency of the designer's work for design of industrial mixers. The preparation of documentation for each calculated version is deemed to be a great advantage that can be used for training purposes and for improving the designer's skills.

REFERENCES

1. Domacsnev, A.D., Design and calculation of chemical apparatus, Moscow, Mechanical engineering, 624 pp(in Russian).
2. Kontorovich, Z. B., Basic chemical calculation machines and apparatus,

applications, traditionally used for shaping the documentation (MS Word, MS Excel, etc.) are developed too.

DOCUMENTING

Each calculated variant and each step of the algorithm calculation option can be documented by transferring the information in the word system (MS WORD). **Figure 21** and **Figure 22** present documentation of a computational version of a particular type of mixer. This documentation is automatically stored and expands the projects database, respectively the designer's skills.

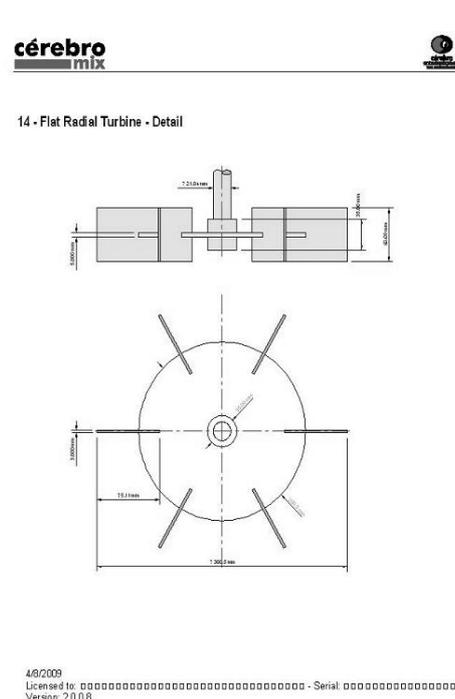


Figure 22. Characteristics of impeller.

Moscow, Mechanical engineering, 744 pp.(in Russian).

3. Laschinskii, A.A., A.R. Tolchinskii, Basic design and calculation of chemical apparatus, Leingrad, Mechanical engineering, 752pp(in Russian).
4. Alpert, L.Z., Basic design of chemical installations, High School, Moscow, 1976(in Russian).
5. Sendov, , S., S. Kraichev, Machines, apparatus and installations in biotechnology, TU-Sofia, 1994.
6. Levenschpil, O., Engineering design chemical techniques, Moscow, Chemistry, 1969.
7. Rosenbrock, H. H., C. Storey, Computational Techniques for Chemical Engineers, Pergamon Press, 328 pp.
8. <http://www.cerebromix.com/>