MouldingSandDB – a modern database storing moulding sands properties research results

J. Jakubski*, P. Malinowski, M. Hajduk

[a] Faculty of Foundry Engineering, University of Science and Technology AGH,
al. Mickiewicza 30, 30-059 Kraków, Poland
* Corresponding author. E-mail address: jakubski@agh.edu.pl

Abstract

The complexity of foundry processes requires the use of modern, advanced IT tools for optimization, storage and analysis of technical data. Properties of moulding and core sands that are collected in research laboratories, manufacturers, and finally in the foundries, are not in use later on. It seems important to create a database that will allow to use the results stored, along with the possibility of searching according to set criteria, adjusted to casting practice. This paper presents part of the database named „MouldingSandDB", which allows to collect and search data for synthetic moulding sands.

Keywords: Database; Green moulding sand; Moulding sand properties

1. Introduction

A large number of data which is being generated in foundry processes is usually not undergoing direct measurements and recordings, especially automatic. Even the data which is measured and stored is not used for an optimisation and computer aided quality control. The access to a higher number of reliable data requires purchasing of the proper measuring equipment and employing additional staff [1]. It seems important to create a database that will allow to use the results stored, along with the possibility of searching according to set criteria, adjusted to casting practice.

One of the authors of this article has prepared a database named "SimulationDB", which allows to efficiently shorten the time needed to develop appropriate technology using the knowledge base and projects accumulated in the database [1 -6]. Using the "SimulationDB" system, the technologist is building a knowledge base, which will be composed of the developed simulation results with full description of technological procedures and recommendations for technology optimization [7].

The database presens in this article focuses on the properties of moulding sands.

Boenisch [8] classified moulding sands into three group, according to the binder kind:
- generation I - mouldings sands with clay,
- generation II - moulding sands with binders,
- generation III - moulding sands without binders, bound with physical factors.

Jelinek [9] completed this clasification with moulding sands:
- generation IV - moulding sands bound with biotechnological factors.

Due to the fact that moulding sands of I and II generation are now used in foundries, the database contains research results of these moulding sands properties.

The part of the database described below contains properties of synthetic moulding sands and may be a source of information for correct moulds composition selection.

2. Researches

"MouldingSandDB" is a database system used for storing the parameters of moulding and quick searching a specific moulding sand fulfilling certain parameters (eg. search criteria: compressive strength, compactibility, permeability).
The "MouldingSandDB"system has been developed using a three-tier architecture client - server, as shown in Figure 1
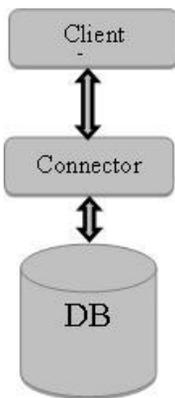

Fig. 1. The three-tier system architecture MouldingSandDB client-server

The "MouldingSandDB" is another after "SimulationDB" database system for the foundry industry from the group of DataBase Foundry Engineers (DBFE). Its main task is to archive the basic parameters of molding such as:
• Moisture,%
• Content of bentonite, parts by weight
• Content of deactivated bentonite,%
• Compressive strength R_c^w, Mpa
• Permeability Pw, $10^{-8}m^2/s*Pa$
• Friability,%
• Compactibility,%
• Apparent density, g/cm^2
• Ignition loss, %

"MouldingSandDB" system is divided into two parts:
• Database
• GUI - Graphical User Interface

The interface is divided into several parts. The interface contains menu, toolbar buttons to quickly navigate through the program and main working window. In this window, there is a possibility of entering the properties of moulding, searching database and plotting graphs for each parameter, etc..
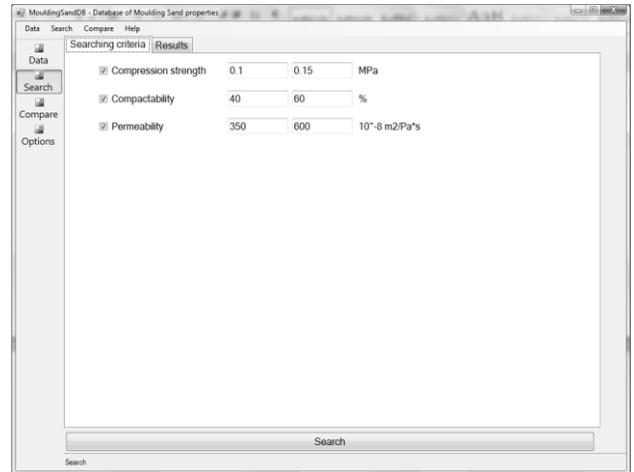

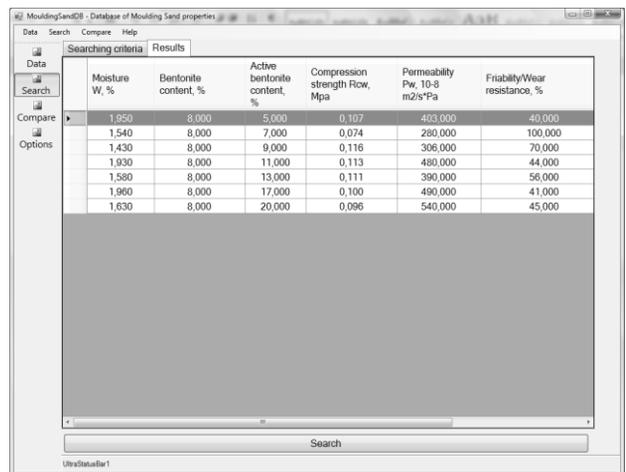Fig. 2. Search for moulding that meet certain parameters

Fig. 3. Results of searching

The figure 2 shows the search criteria, which can be used to search moulding, that meet the required parameters. Depending on client needs, there is a possibility of modifying the criteria according to demands. The results of an example search are shown on figure 3.

Clicking on a selected moulding sand opens a window of a specific moulding sand properties. One can see all the properties for each series, which fulfil the chosen criteria. Different graphs can be generated based on information stored in the database (Fig. 4 – 8).
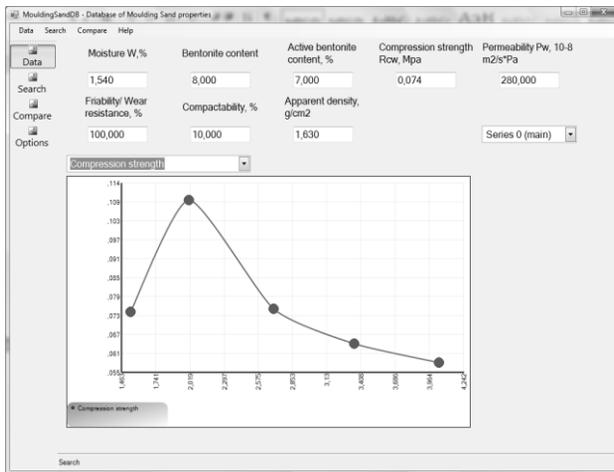
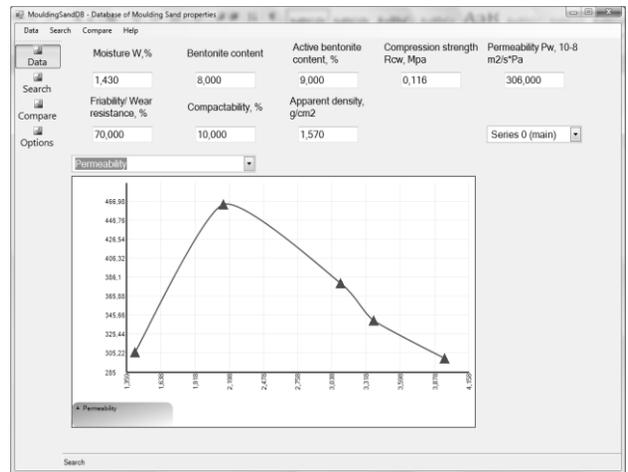Fig. 4. Influence of moisture on compressive strength R_c^w, for moulding sand fulfiling search criteria

Fig. 6. Influence of moisture on permeability for moulding sand fulfiling search criteria

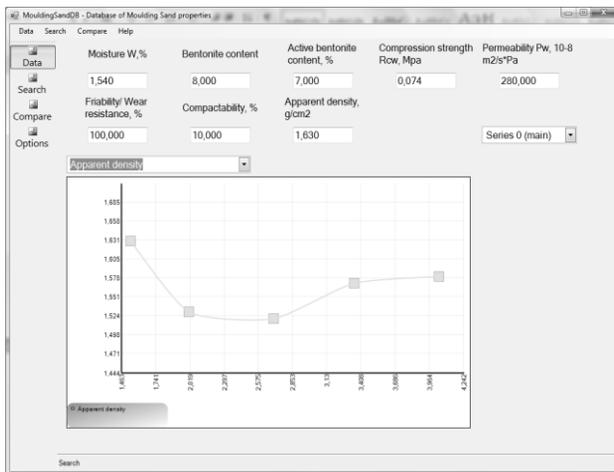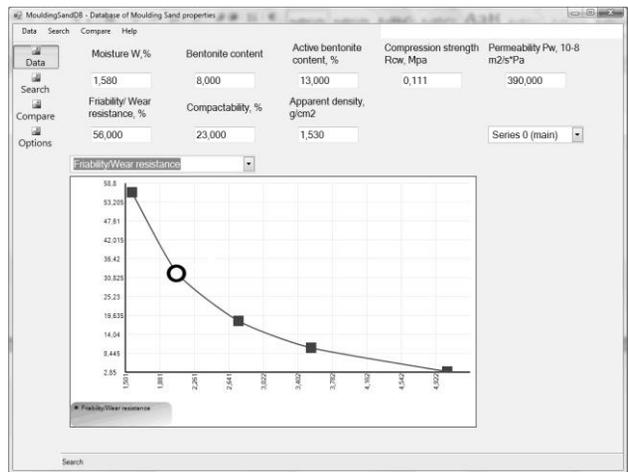Fig. 5. Influence of moisture on apparent density, for moulding sand fulfiling search criteria

Fig. 7. Influence of moisture on friability, for moulding sand fulfiling search criteria

The graphs show changes of the moulding sand properties as a function of moisture, throughout the range of research moisture changes. The created database has the ability to select the point on the curve that meet the set criteria. The example is shown on Figure 7.

In the presented version of the database it is possible to view graphs only for one selected moulding sand. Developing a function which enables to view graphs of data for a number of molding, meeting selected criteria to facilitate their comparison will be the next step. The following stage of the database development will be introducing a module for comparing the properties of the core sand binders.

Assumed search criteria will enable the database search for moulds composition (amount of ingredients, type of binder), manufacturing technology, technological properties (bending strength, tensile strenght), or bench life.
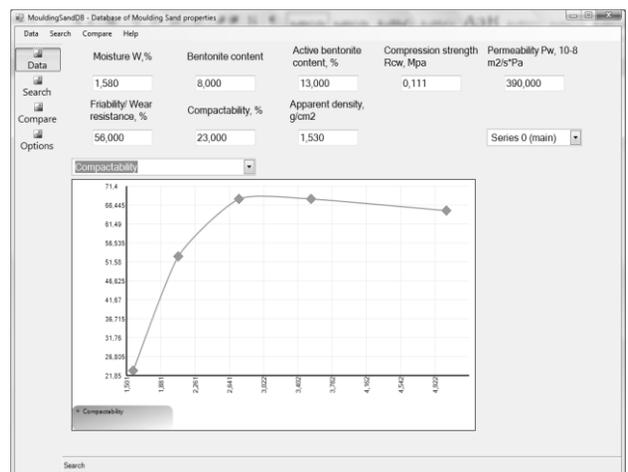

Fig. 8. Influence of moisture on compactability, for moulding sand fulfiling search criteria

4. Conclusion

Creating databases for industry and science is a step towards the computerization of enterprises, streamline procedures and business processes, which greatly reduces production costs and speeds up the development of appropriate technologies, increasing finally the competitiveness of companies in the national and international scale.

The database presented in this article shows the possibility of searching and comparing collected research results for the synthetic moulding sands. Further development of the database with module for II generation moulding sands will enable a complex search for relevant parameters of moulding and core sands according to established criteria.

Acknowledgments

References

[1] Z. Ignaszak, R. Sika, The system to explore the chosen production data and its testing in the foundry. Archives of Mechanical Technology and Automation. 2008, Vol. 28, 1, pp. 61-72 (in Polish).

[2] J.S. Suchy, P. Malinowski, Intelligent informatics system in numerical casting simulation. 45th Foundry Days Proceedings of the 5th International PhD Foundry Conference (electronic dokument), Brno, 2008, pp. 18-19.

[3] J.S. Suchy, P. Malinowski, SimulationDB - Database for Foundry Engineers as innovative and intelligent solution in foundry industry. Junior Euromat 2008, The Federation of European Materials Societies, The Major Event for Young Materials Scientists, Laussanne, Switzerland, 2008.

[4] P. Malinowski, J.S. Suchy, Casting quality improvement, searching and analyzing processes acceleration and better data exchange by using Database for Foundry Engineers - SimulationDB system. Proceedings of the 48th International Foundry Conference, Portoroz, Slovenia, 2008.

[5] P. Malinowski, J.S. Suchy, Database for Foundry Engineers - SimulationDB as useful and essential tool for inexperienced technologist. World Technical Forum, Brno, Czech Republic, 2009.

[6] P. Malinowski, J.S. Suchy, Interactive database system "SimulationDB" - innovations in the foundry industry. Proceedings of the 4th Cracow Conference of New Scienstist, Cracow, Poland, 2009, pp. 127-133.

[7] P. Malinowski, J.S. Suchy, Database for foundry engineers – simulationDB – a modern database storing simulation results. Journal of Achievements in Materials and Manufacturing Engineering. 2010, Vol. 43, pp. 349–352.

[8] St. M. Dobosz, Water in moulding and core sands, Cracow, 2004 (in Polish).

[9] P. Jelinek, The binding systems of foundry moulding sands. Ostrava, 2004 (in .Czech).