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Semi-automatic data linkage and acquisition process for the preparation of Austempered Ductile Iron

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Austempered Ductile Iron (ADI) is the result of heat treatment carried out on the cast iron with nodular graphite. Various parameters of the manufacturing process such as temperature and time in different stages of the process, and also the chemical composition are responsible for the mechanical properties of final material. Data concerning processes of ADI manufacturing derived from experiments could be find in the Web. The paper describes methodology of collecting experimental data concerning the process of ADI manufacturing as well as Web exploration with use of semantic techniques and the framework developed in the School of Information Technology and Electrical Engineering at The University of Queensland, named OGDL: Ontology Guided Data Linkage.

Keywords: *Austempered Ductile Iron, thermal treatment, properties, data integration, ontology.*

1. Introduction

Austempered Ductile Iron (ADI) is the result of heat treatment carried out on the cast iron with nodular graphite. Excellent combination of properties obtained in ADI, including the strength, toughness and fatigue behavior, makes this material a successful substitute for steel or aluminum alloys. ADI has a high fatigue strength, higher than aluminum, is resistant to abrasive wear like steel, but most of all – its use can significantly reduce the cost of production. An important advantage for the automotive industry is also high damping capacity, as a matter of fact, by 40% better than that of steel [1-2].

The technologically demanding process of the ADI is a good example of how important the accurate information about various process parameters really is. As described above, various parameters such as temperature and time in different stages of the process, and also the chemical composition exert a strong influence on the final properties of this material.

The aim of the project was to propose a methodology supporting the task of collecting the comparative data on studies of the mechanical properties of ADI. Collecting of research data is an important step in the process of finding the optimum design solutions for newly made products - experimental data allow us properly calibrate the manufacturing process of ADI to let the final product achieve the required properties. Parameters of the ADI production process, i.e. the time and temperature of austenitizing and austempering, as well as the alloying elements added to ductile iron affect the ADI properties. The design process can use research data collected, among others, from the Web [3-4].

The process of data acquisition can be supported by semantic technologies, including ontologies which are descriptive logic formalism. The authors propose the use of a genuine proprietary framework developed in the School of Information Technology and Electrical Engineering at The University of Queensland, named OGDL: Ontology Guided Data Linkage which is also presented in the paper. The framework reveals hidden relationships between data sources towards patterns discovery at different levels of data abstraction.

2. Ontology-Driven Data Acquisition

The aim of the first stage of the work was to collect comparative data on the manufacturing process of ADI. Foundry Research Institute in Cracow has an experienced team of engineers conducting research on this material. Studies of this material are also conducted in nearly all parts of the world. The diversity of the experiments results in the development of new variants of the heat treatment, and thus in new ways to obtain the required properties of this material.

Ontology in computer science is a formal record of the definition of a certain part of the knowledge expressed in the form of a taxonomy of related classes. In other words, ontology is a semantic model of

defined field of knowledge. Ontologies are computerized implementation of description logic [5-7].

Based on the literature, one can create a very accurate and reliable knowledge base. Semantic model of relationships existing between the data could reduce required experience of the technologist to evaluate the data found, and most of all – time needed. The authors propose the use of a genuine proprietary framework developed in the School of Information Technology and Electrical Engineering at The University of Queensland, named OGDL: Ontology Guided Data Linkage [8].

The framework produces an ontology based on the data model of the heterogeneous data sources. An ontology is capable of describing the properties of data objects from different application domains. Clusters of object are connected with the domain ontology of ADI and the semantic transformation of the relations among the sources is proceeded.

Having the data classified with the use of the domain ontology, knowledge based data search among the data sources is possible.

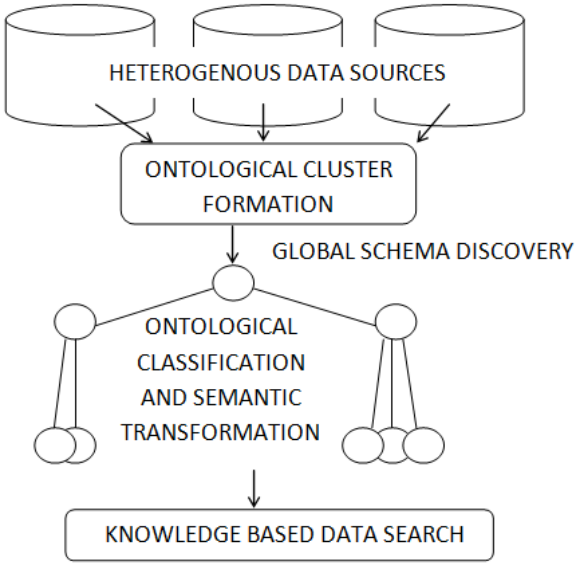

Fig. 1 Simplified schema of process flow with Ontology Guided Data Linkage framework.

3. Conclusions

Presented methodology enables the use of a modern approach to data integration, which is the Agile Data Integration system. Collecting of research data and searching with the use of knowledge based systems is an important step in the process of finding the optimum design solutions for newly made products - experimental data allow us properly calibrate the manufacturing process of ADI to let the final product achieve the required properties. The design process can use the research data collected, among others, from the Web. As indicated in the article, the process of data acquisition can be supported by the semantic technologies.

Acknowledgements

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