INFLUENCE OF INCREASED TEMPERATURE FLUDIZED BED DRYING OF ALPHASET AND FLOSTER MOULDING SAND IN RECLAMATION PROCESS ON THE QUALITY OF THE RECLAIM

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Abstract

Nowadays the efficient reclamation of used moulding sand is a vital part of foundries policies from both economical, technological and environmental-friendly points of view. The ability to use reclaimed sand of proper quality not only allows to save money that would have to be spent on new sand, it also allows the foundry to have smaller storage area and to reduce the negative impact on the environment caused by worn out moulding sand. The purpose of the study was to identify the impact of increased temperature fluidized bed drying of alphaset and floster moulding sand in their reclamation process on the quality of the reclaimed sand. Moulding sand reclamation plant taken into examination used in cast steel and cast iron foundry Odlewnia Staliwa Łabędy utilizes mechanical reclamation process. Part of this process is fluidized bed drying of the sand in 120 °C. This article presents the comparison of two obtained reclaims: first with the drying temperature of 120 °C, second with room drying temperature. Preliminary research revealed that humidity of the reclaim is not affected whether the temperature is increased or not. To determine and compare the quality of both obtained reclaims their screen analysis and ignition loss were carried out alongside with bending and tensile strength tests of moulding sand prepared with the use of two examined reclaims.

Keywords: Reclamation, moulding sand, floster, alphaset

1. INTRODUCTION

In these days in order to be competitive at the market every foundry needs to optimise its expenses alongside with the produced castings quality continuous improvement [1]. To achieve that it is very important to use the best available raw materials, alloy additions and technologies on each production level [2]. Part of this process may concern diversification of material providers and subcontractor services, but also optimization of manufacturing technology [3]. Both moulding, melting and feeding processes must be taken into consideration to ensure the optimal result. Reclamation of moulding sand is perfect way to reduce necessary expenses of almost every foundry using sand moulding, it also has positive impact on the environment as it allows to reduce the amount of wastes produced by the foundry and it allows the foundry to have smaller storage area [4-7]. Moulding sand reclamation plant, produced by Richards Engineering, which was the subject of the research is located in Odlewnia Staliwa Łabędy foundry and it performs mechanical reclamation process [8-13]. Part of this process is fluidized bed drying of reclaimed sand in 120 °C which according to the producer is intended to reduce the humidity of the reclaim. This article answers the question if increased temperature drying of alphaset and floster moulding sand reclaim is indispensable part of the reclamation process even if the humidity of the moulding sand is low.

2. EXPERIMENTAL PART

The purpose of the research was identification of the impact of increased temperature fluidized bed drying on the quality of the reclaimed sand. The subject of the research was reclaim of alphaset and floster moulding

sand obtained with two different drying temperatures in two different weather conditions. Parameters associated with sample preparation conditions were shown in **Table 1**.

Table 1 Parameters associated with sample preparation

sample	**I**	**II**	**III**	**IV**
drying temperature	120 °C	120 °C	ambient	ambient
ambient temperature	9 °C	13 °C	9 °C	13 °C
air humidity	95 %	35 %	95 %	35 %

To ensure as low as possible humidity of the reclaim, moulding sand reclamation plant placed in Odlewnia Staliwa Łabędy foundry is equipped with the ability to increase the temperature of the air used for fluidized bed drying up to 120 °C. In the case where high humidity of moulding sand is a problematic issue this solution is justified. However in the case of Odlewnia Staliwa Łabędy foundry the humidity of the sand was quite low which raised the question if increased temperature drying is really indispensable. Preliminary research involved determination and comparison of humidity of reclaimed moulding sand exiting the fluidized bed dryer with and without increased drying temperature. **Table 2** shows humidity of examined samples before and after fluidal bed drying. As it can be noticed initial humidity is low enough to ensure complete reduction of water content whether with or without increased temperature drying.

Table 2 Humidity of examined samples

sample	**I**	**II**	**III**	**IV**
initial humidity [%]	0.02	0.06	0.06	0.02
final humidity [%]	0.00	0.00	0.00	0.00

Examination of ignition loss resulted in the conclusion that increased drying temperature does not result in the decrease of it. Samples dried in ambient temperature exhibited the same or even smaller ignition loss than samples dried in increased temperature. **Table 3** shows ignition loss measured after thermal cycle conducted with the use of laboratory furnace. Parameters of the thermal cycle were:

- heating speed 300 °C / h,
- final temperature 1200 °C,
- hold time 1 h.

Table 3 Ignition loss of examined samples

sample	**I**	**II**	**III**	**IV**
initial weight [g]	58.191	58.859	58.432	58.425
final weight [g]	58.045	58.712	58.297	58.280
ignition loss [%]	0.2509	0.2497	0.2310	0.2482

Screen analysis results presented in **Table 4** and on **Figure 1** prove that increased temperature of drying does not result in any changes in reclaims grain size distribution and thus the homogeneity index in all samples was similar and over 92.5 %.

Table 4 Screen analysis of examined samples

sample	I	II	III	IV
[mm]	[%]	[%]	[%]	[%]
1.60	0.03	0.02	0.01	0.00
0.80	0.93	0.89	1.08	0.61
0.63	3.86	4.33	4.45	3.09
0.40	41.95	45.18	45.36	42.73
0.32	29.35	27.82	28.19	29.47
0.20	21.40	19.55	18.77	21.64
0.16	1.89	1.74	1.53	1.91
0.10	0.51	0.45	0.39	0.53
0.071	0.04	0.02	0.02	0.02
0.056	0.03	0.00	0.01	0.00
bottom	0.01	0.00	0.00	0.00
binder content	0.34	0.30	0.35	0.23
homogeneity index	92.7	92.55	92.51	93.84

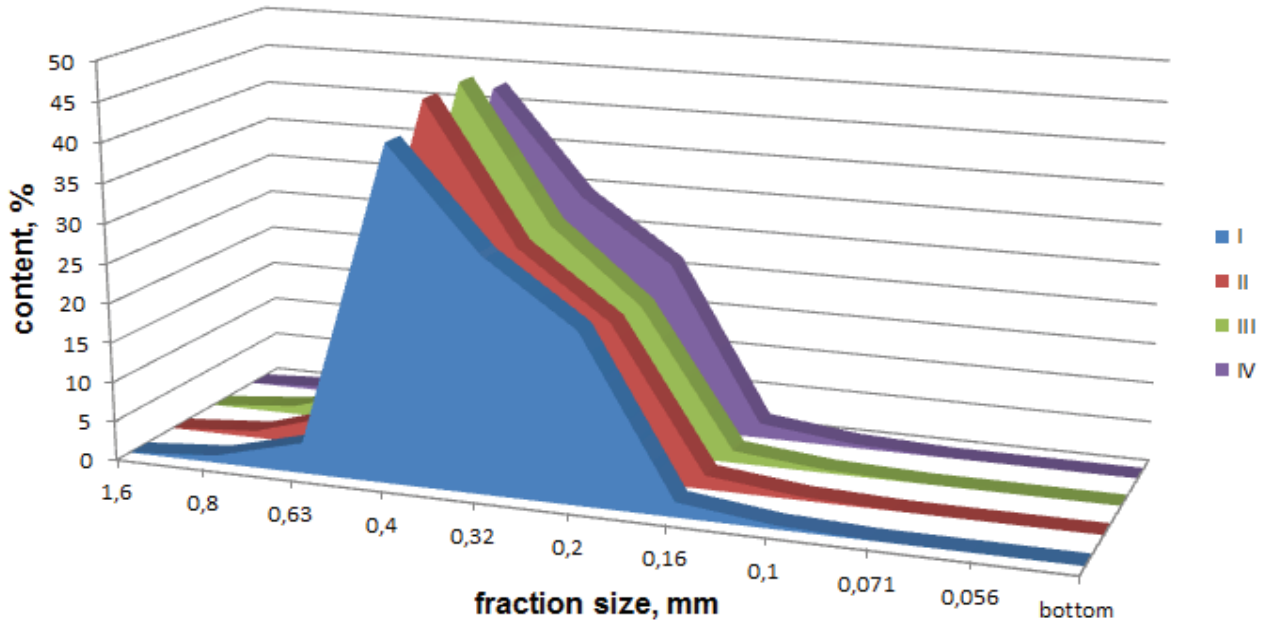

Figure 1 Screen analysis of examined samples

Measurements of tensile (Rm) and bending (Rg) strength, permeability [P] and the Vicat time shown in **Table 5** were performed 24h after moulding in order to compare the quality of the reclaim and its usefulness in moulding sand preparation. Moulding sand was made out of each sample of the reclaim with the addition of 3.5 % of R-145 sodium water glass and 0.39 % of MACH 0 binder. As it can be seen on **Figure 2** and in **Table 5** tensile properties of samples dried in ambient and elevated temperature are not divergent. Moulding sands prepared with the use of reclaim dried in ambient temperature have better permeability and longer Vicat time than in the case of reclaim dried in increased temperature.

Table 5 Bending and tensile strength, permeability and Vicat time of obtained moulding sands

sample	I	II	III	IV
Rm [MPa]	0.34	0.26	0.27	0.25
Rg [MPa]	0.70	0.64	0.73	0.60
P [$m^2 \cdot Pa^{-1} \cdot s^{-1}$]	547	558	588	591
Vicat [min]	40 / 50	40 / 50	45 / 60	45 / 60

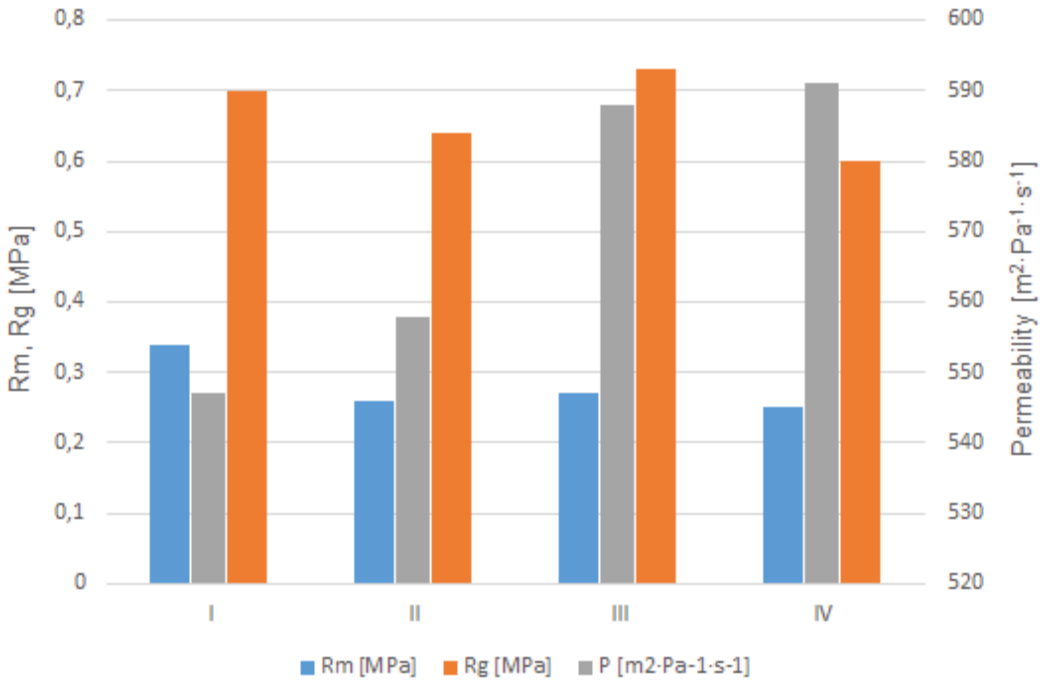

Figure 2 Tensile and bending strength with permeability of obtained moulding sands

3. CONCLUSIONS

Based on conducted studies and obtained results the following conclusions were drawn:

- in Odlewnia Staliwa Łabędy foundry conditions the elevated temperature of fluidized bed drying of reclaimed moulding sand does not grant enhanced properties of reclaim in comparison to ambient temperature drying,
- taking into consideration the volume of production in Odlewnia Staliwa Łabędy and price of gas it can be estimated that discontinuance of heating process can result in large savings,
- resignation from increased temperature drying will have positive impact on the environment due to lack of gasses produced during the combustion of gas used for heating of fluidized bed,
- in conditions where the humidity of initial moulding sand is higher increased temperature drying might be necessary in order to obtain high quality reclaim,
- further studies concerning optimization of floster and alphaset moulding sands reclamation process will be performed.

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