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Influence of the Reclamation Process Intensity in the REGMAS Reclaimer on the Purification Degree of the High-silica Matrix

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Abstrakt

The investigation results of the reclamation of spent moulding sands with furfuryl resin are presented in this paper. The reclamation process was performed in the secondary reclamation chamber of the REGMAS 1.5 vibratory reclaimer. 70 kg portions of moulding sands, previously subjected to the primary reclamation and dedusting, were used. The secondary reclamation was performed in two stages: the first consisted of determining the reclaimer intensity at various reclamation times (5 min, 10 min and 15 min) and various electrovibrator frequencies (40 Hz, 50 Hz and 60 Hz), the second consisted of determining the influence of additional crushing elements on the intensity of processes.

Keywords: Environmental protection reclamation, Moulding sand, Grain size analysis, Destruction

1. Introduction

The reclamation process of spent moulding sand with furfuryl resin can be carried out in devices for the thermal reclamation [1]. The efficiency of such process is very high, however costs related to performing this process, buying of additional crushing and dedusting devices, cause that the price to quality ratio is very high.

The mechanical reclamation applied in devices realising jointly processes of rubbing, grinding and crushing [2,3], due to which coatings of spent binders are removed from matrix grains, allows to decrease significantly reclamation costs. The REGMAS 1.5 vibratory reclaimer is such a device. The innovatory structure of the device allowed to integrate all necessary processes such as: crushing, reclamations, transport and dedusting in one compact

device [4-7], achieving efficient reclamations and low operating costs.

The performed tests were aimed at obtaining information concerning the influence of the frequency of rotodynamic motors and the process duration on the purification degree of high-silica matrices.

2. Investigations range

A spent moulding sand with furfuryl resin originated from one of the domestic foundry plants was used in tests. This sand, after the primary reclamation and dedusting, was divided into 70 kg portions. The process testing the influence of the REGMAS reclaimer (Fig.1.) on a spent moulding sand was performed in the

lower part of the device, in the so-called secondary reclamation chamber.

The process was performed in two stages. The first one consisted of investigations of the reclamation degree of the spent moulding sand portion in the prototype reclaimer without any additional crushing elements, while in the second stage the influence of additional crushing elements - in the form of spheres on the intensity of processes was tested.



Fig. 1. Prototype vibratory reclaimer

The reclamation was carried out at a constant placement of unbalanced masses of rotodynamic motors corresponding to 70 %

of the maximum exciting force, while the reclamation degree of the portion subjected to the process was controlled by:

- frequency of operation of electrovibrators, which was: 40 Hz, 50 Hz and 60 Hz,
- operation time of the reclaimer, which was, in turn: 5 min, 10 min and 15 min.



Fig. 2. Cast iron spheres, constituting additional grinding-crushing elements of the prototype reclaimer

The schematic presentation of the performed tests is given in Fig. 3.

The obtained reclaim was subjected to the following investigations:

- amount of dusts generated due to the reclamation,
- laser analysis, sieve analysis,
- loss on ignition, LOI,

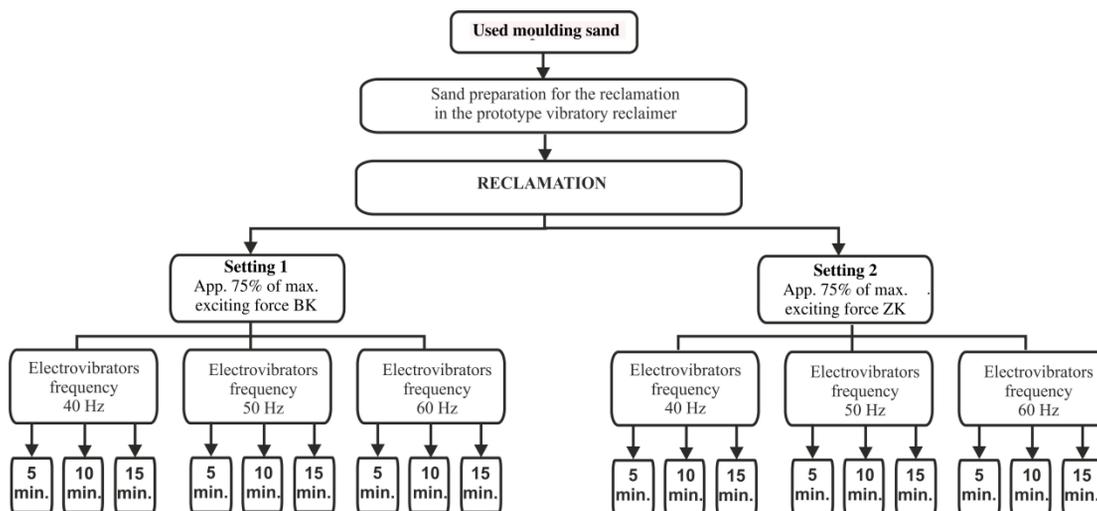


Fig. 3. Scheme of stage 1 of the performed tests of the reclaimer

* ZK – Process with additional crushing elements, BK – Process without additional crushing elements

3. The obtained results

The efficiency factor of the reclamation process calculated on the basis of LOI tests (Fig. 4) during the first stage of tests, it means when the reclaimer operated without additional crushing elements, indicated growing of this factor along with increasing the operational frequency of rotodynamic electrovibrators. The efficiency factor achieves its maximum value, close to 30%, at the frequency being 60 Hz. The second stage confirms these data, however it can be noticed that

additional crushing elements improve the reclamation process efficiency.

In both cases the maximum efficiency of the performed process was obtained for the frequency of 60 Hz and for 15 minutes of the operation time. The additional crushing elements increased the reclamation process efficiency to 37%.

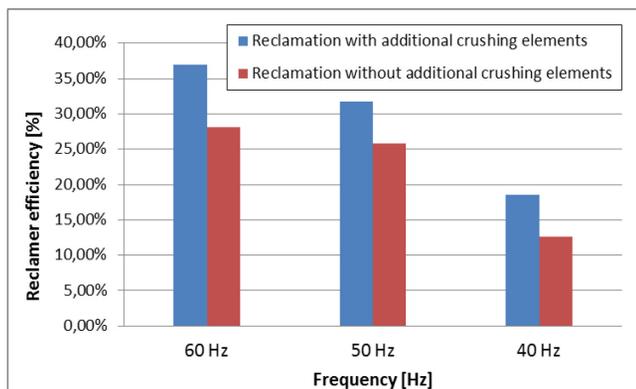


Fig. 4. Reclaimer efficiency after 15 minutes of performing the process

It can be noticed when analysing the obtained results (Fig. 5) that the surface area between the grain composition function of the spent moulding sand and the moulding sand after the reclamation process - performed without the additional crushing elements - is smaller, than in case of the process performed with additional crushing elements. This confirms the statement that the process performed with additional crushing elements is more efficient.

The reclamation process of spent matrices is based on thinning the layer of spent binders on high-silica grains of the matrix, and in consequence on changing diameters. Diagrams shown in Fig. 6a and 6b illustrate this feature. The process, without additional crushing elements, is presented in Fig. 6a, and when comparing it with the second diagram it is possible to notice that the increased frequency of drive motors operations as well as prolongation of the process time cause thinning of the binding material on matrix grains. Additional crushing elements cause intensification of the processes occurring.

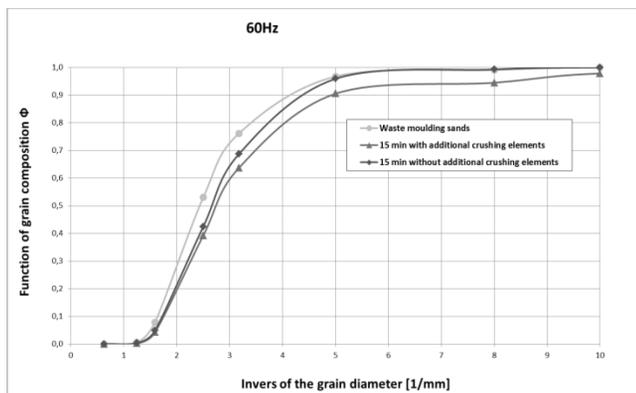


Fig. 5. Function of grain composition for the electrovibrators operation frequency being 60 Hz and the reclamation time equal to 15 minutes

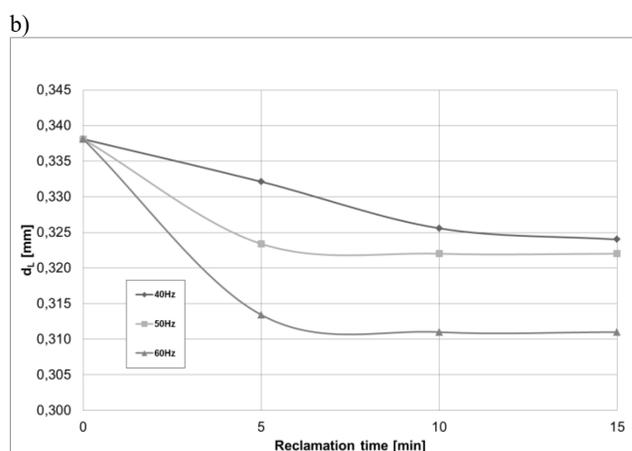
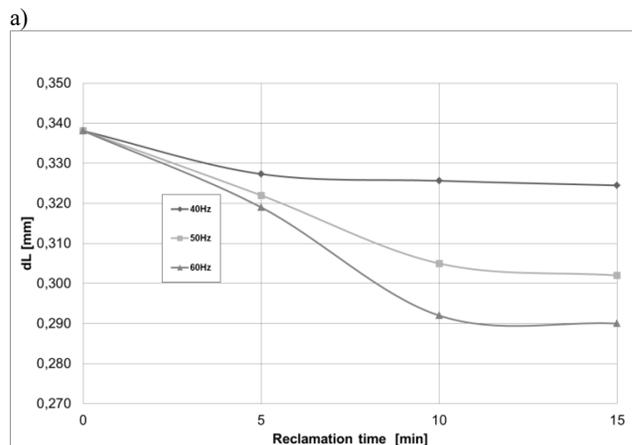


Fig. 6. Average diameter d_L , characteristic for the operation frequencies: 40 Hz, 50 Hz and 60 Hz at operation times of the device being 5 min, 10 min. and 15 min. a) with additional crushing elements, b) Without additional crushing elements

4. Conclusions

The performed investigations allow to draw conclusions written below.

- The prolongation of the reclamation process and increased frequency of operation of drive motors favourably influences the process.
- The high-silica matrix purification process performed with additional crushing elements causes the intensification of reclamation processes.
- The reclamation process for the stages two achieved nearly 40% efficiency, which in case of the mechanical reclamation is the satisfactory value.

In case of spent moulding sands susceptible to the reclamation process this process can be successfully carried out for the frequency of 50 Hz without additional crushing elements.

Moulding sands difficult for a reclamation, in which coatings of spent binders are more elastic and less susceptible to crushing, will require operations with additional crushing elements.

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