

# A new ester hardener for moulding sands with water glass having slower activity

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## Abstract

The article takes into consideration the researches concerning inputting the new hardener to moulding sands with water glass, carried out in ester technology. Investigations are continuation of works connected to hardener based on carbonic acid's esters, that significantly upgrades the ability of these moulding sands to mechanical reclamation. Its' nuisance is short vitality. This is why, new investigations were taken to elaborate another hardener keeping the positive characteristics of the previous one and allowing the wider usage of technologies of loose self-hardened moulding sands with water glass.

**Key words:** Moulding sand, Water glass, Hardener

## 1. Introduction

Due to a very low harmfulness for the natural environment, the role of moulding sands with water glass is getting bigger in foundry practice. As the hardeners for these moulding sands in foundry practise, the most widespread are the esters of acetic acid from 2- to 5-unit multihydroxical alcohol. The gradual hydrolysis of triacetate of glycerine begins with the forming of diacetate of glycerine ( I grade) and finishes (III grade) with forming of acetic acid and glycerine, which is shown below [1]. Gradually educing acetate acid reacts with NaOH with educing of sodium acetate, which - in the later stages of hardening - crystallises and strengthens  $\text{Si}(\text{OH})_4$  gel with the forming crystals  $\text{CH}_3\text{COONa}\cdot 3\text{H}_2\text{O}$ .

According to both P.Jelinek's view [1] and confirming own researches, it was delivered that the compound,  $\text{CH}_3\text{COONa}\cdot 3\text{H}_2\text{O}$ , creating during the reaction, accumulates in the process of mechanical reclamation leading to the fall of moulding sand's technological properties. Moreover, this

compound is responsible for the plastic state of moulding sand, appearing in case of bigger moulds or cores. This state can result in own deformation of moulding sand, and even cores' destruction in unfavourable conditions.

Presented figure (Fig. 1) show the high harmfulness of this compound. There comes a conclusion, that the limiting contents of sodium acetate within the reclaim, should not exceed 0,10%.

Using even very effective reclamation systems, it will be difficult to fulfil this condition. That is why, there were trials to elaborate the ester hardener of a new generation based on carbonic acid ester – propylene carbonate.

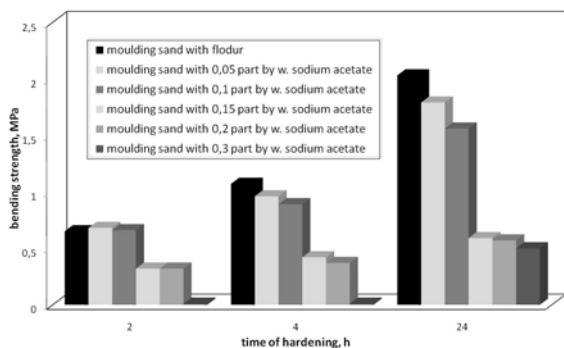


Fig. 1. The influence of sodium acetate on bending strength of moulding sand with water glass hardened with flodur hardener [2]

In few previous publications, authors [2-6] presented investigations with using the new ester hardener for loose self-hardened moulding sands with water glass, called Ixional SD. Researches showed that new hardener significantly enhances the quality of sands reclaimed with mechanical methods. At the same time it was presented, that new hardener increases the kinetics of hardening process of moulding sands with water glass. Ixional SD hardener shall be treated as a „fast one“. It has advantages, because the higher resistance after 2 and 4 hours of hardening was reached. Unfortunately, as a consequence there is a lower strength of moulding sand after 24 hours of hardening. By high temperatures (for example - during summer) or in case if moulding sands requires a long vitality – it can be too fast.

## 2. Experimental results

### 2.1. Investigations of properties of moulding sands with Ixional SD hardener

In the previous stage of researches [2], the trials were done to choose (elaborate) a special slowing agent for moulding sands with water glass, hardened with Ixional SD hardener. After the analysis of binding process, it was decided that glycerine triacetate, here described as a triacetate, will play a role of such slowing agent /moderator. Moulding sands with following composition were taken into elaboration:

Quartz sand	100 parts by weight
Water glass 145 hardener	3 parts by weight
	0,3 parts by weight

The share of slowing agent (triacetate) in hardener (Ixional SD) was changed within the range of 0 – 100% of triacetate in general amount of hardener.

As a measurement of vitality, time was chosen, after which moulding sand's strength decreases by 30% in proportion to signs on shape blocks done right after mixing the moulding sand. Figure 2 presents the final results of measurements of life of moulding sands with hardener Ixional SD and changeable amount of glycerine triacetate as a slowing agent.

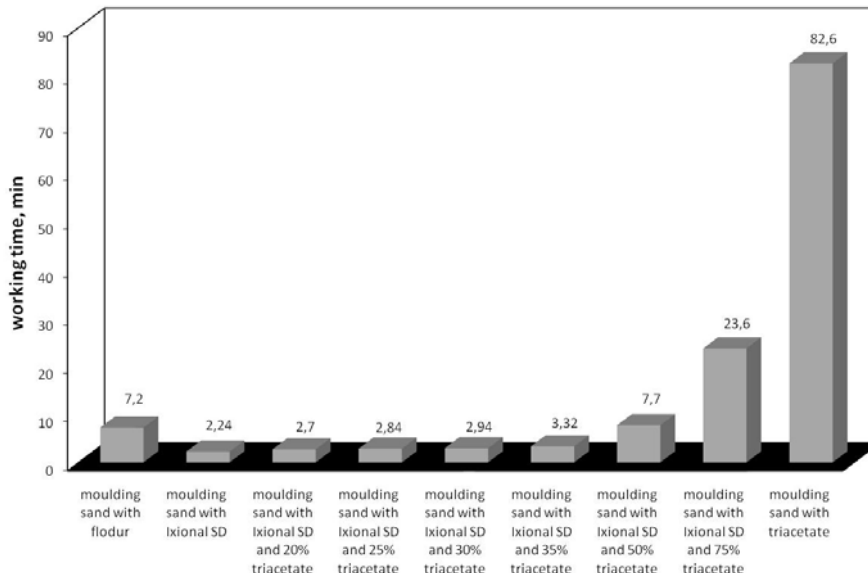


Fig. 2. The influence of glycerine triacetate on change of working time of moulding sands hardened with Ixional SD hardener [5]

On the figure it is seen, that the addition of triacetate into moulding sand with water glass hardened with Ixional SD, allows to steer properly the life of moulding sand.

It varies from approximately 2 to even 82 minutes when 100% of hardener is triacetate. Basing on applied researches and the usage of proposed slowing agent, it is possible to regulate efficiently the

speed of moulding sand's binding and the strengths obtained in opportune time ranges.

It has to be remembered that using the slowing agent's additive (glycerine triacetate) to hardener results in generating the harmful sodium acetate in moulding sand, which was a reason of elaborating the new hardener[6].

## 2.2. Investigations of properties of moulding sands with Jeffsol BC hardener

The presented short life of moulding sands hardened with Ixional SD hardener was a reason for looking for next hardener for moulding sands with water glass. This is why, as a result of applied analysis and pre-trials, appeared a proposal to use a new hardener, based on new ester - butylene carbonate, which similarly as Ixional SD, does not introduce harmful sodium acetate into moulding sand. New hardener, named Jeffsol BC, should ensure significantly slower binding of moulding sand, which results in longer life and vitality.

Figures 3-5 present comparison of selected technological properties of moulding sands with water glass hardened with Ixional SD and Jeffsol BC hardeners. Moulding sands with following composition were taken into elaboration:

Quartz sand 100 parts by weight  
 Water glass 145 3 parts by weight  
 hardener 8 - 10% in proportion to binder's content

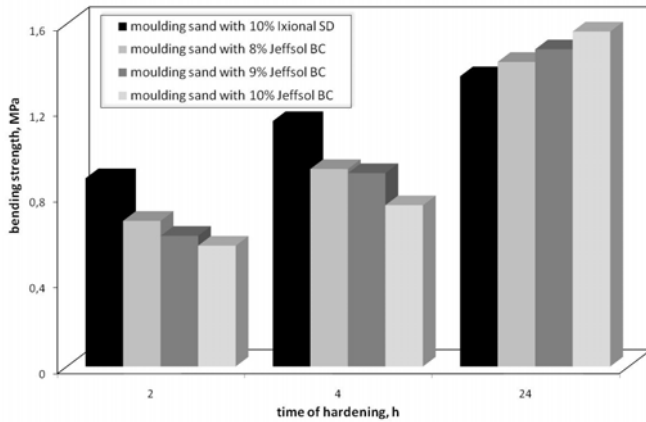


Fig. 3. The influence of time of hardening on bending strength of moulding sands hardened with Ixional SD and Jeffsol BC hardener

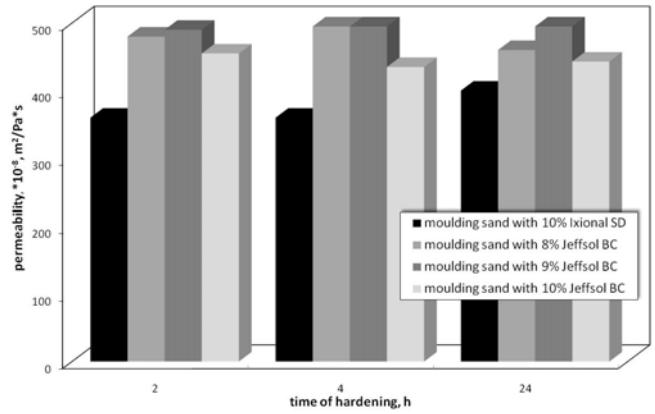


Fig. 4. The influence of time of hardening on permeability of moulding sands hardened with Ixional SD and Jeffsol BC hardener

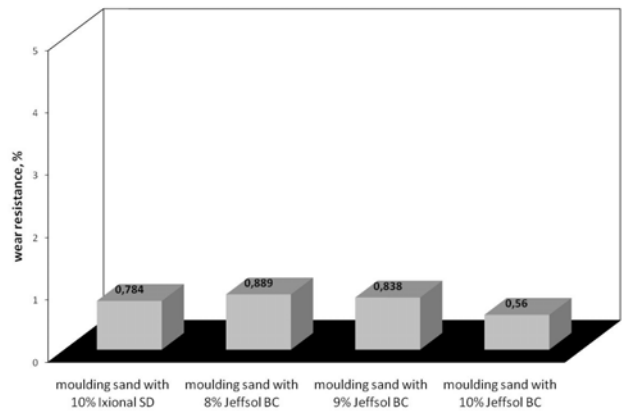


Fig. 5. The influence of time of hardening on wear resistance of moulding sands hardened with Ixional SD and Jeffsol BC hardener

Figure 3 shows that moulding sands hardened with Jeffsol BC hardener in proportions of 8 to 10% of binder, reach lower strengths after 2 and 4 hours than moulding sands hardened with Ixional SD.

However, after 24 hours their strength is higher.

It means that new hardener is much „slower” and allows to receive higher strengths. New hardener upgrades also the permeability of moulding sand (Fig. 4). Moulding sand hardened with 10% of Jeffsol BC hardener also reveals, what is very significant in these moulding sands – lower wear resistance (Fig. 5).

## 3. Conclusions

The applied researches of loose self-hardened moulding sands with water glass and the combination of Ixional SD hardener and glycerine triacetate as a slowing agent, let steer the vitality of moulding sand in a very wide range (from 2 to approximately 80 minutes). It is extremely crucial for industrial practice because it

makes possible choosing the parameters of process depending on conditions and terms, that are present in particular works.

Long vitality of moulding sand after inputting into it the triacetate, results however in generating the unfavourable sodium acetate within the moulding sand. That is why the efforts of elaboration of a new, slower hardener became advisable.

Within the range of works, a new, slower hardener was elaborated – named Jeffsol BC, which guarantees longer vitality of moulding sand and enhances the permeability and wear resistance of moulding sand and also its' strength after 24 hours of hardening.

## Acknowledgements

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