IMPROVEMENT OF COLLAPSIBILITY OF SODIUM SILICATE BONDED CORES FOR ALUMINIUM CASTING

J. Hedjazi

Iran University of Science and Technology
Faculty of Metallurgy and Materials, Tehran, Iran

Received September 1988

Abstract This paper examines the compressive strength of sodium silicate bonded cores for aluminium casting with different additives. Various materials are used as additives among which it is found that 5% sand size bauxine has the best effect on both gas strength and de - coring 98.5% silica content sand with 70-90 AFS No. with 4% sodium silicate is used. The results indicate that although very good collapsibility is achieved by 2% wood flour, its low gas-strength leads the casting towards various defects.

چکیده دراین مقاله، استحکام ماهیچه‌های ساخته شده با چسب سیلیکات سدیم (روش CO_2) برای دو حالت پس از گازدهی و پس از ریخته گری آلومینیم مورد بررسی قرار گرفته است. افزودنی هایی نظیر خاك اره و بوکسیت برای افزایش تلاشی پذیری مورد آزمایش قرار گرفتند که در میان آنها با افزودن ۵٪ بوکسیت به مخلوط ماسه فیروزکوه (۹۸/۵ درصد خلوص) و ۴٪ سیلیکات سدیم بهترین نتایج در استحکام پس از عملیات CO_2) و پس از باررریزی آلومینیم حاصل گردید. در این آزمایش مشخص شد که اندازه ذرات بوکسیت نیز در استحکام اولیه و تلاشی پذیری انتهائی موثر بوده و نتیجه بهتر هنگامی حاصل می‌شود که تقریباً اندازه افزودنی با اندازه ماسه برابر باشد AFS ۷۰-۹۰. علاوه بر آن نتایج حاصل بیانگر این نکته است که هر چند تلاشی پذیری مخلوط ماسه ماهیچه با ۲٪ خاك اره بهبود می یابد ولی استحکام کم ماهیچه پس از عملیات CO_2 موجب بروز عیوب مختلفی می‌شود.

INTRODUCTION

Sodium silicate or "water glass" has been used as a binder and adhesive for at least 120 years. Until the early 1950's the only practical technique for binding foundry moulds and cores with water glass required backing to dehydrate the binder and to rigidify the core and mould [1].

The first practical development was the CO_2 process in which the mould or core rigidify with the passing of CO_2 gas through them and by complex physical and chemical reactions of both gelation and dehydration of sodium silicate solutions [2].

The many advantages of the CO_2 process led to research concerning the fundamental aspects of the properties [3-7]. The effect of such parameters as sand size, gassing, amount of binder and SiO_2/Na_2O ratio of binder and additives have been investigated [8,9]. The

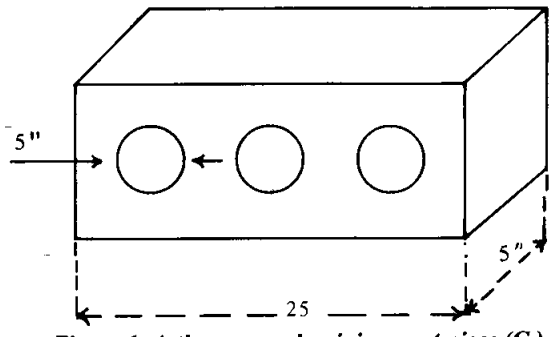


Figure 1. A three core aluminium cast piece (C)

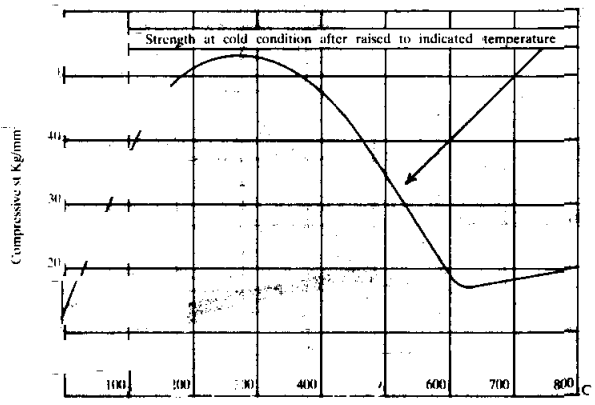
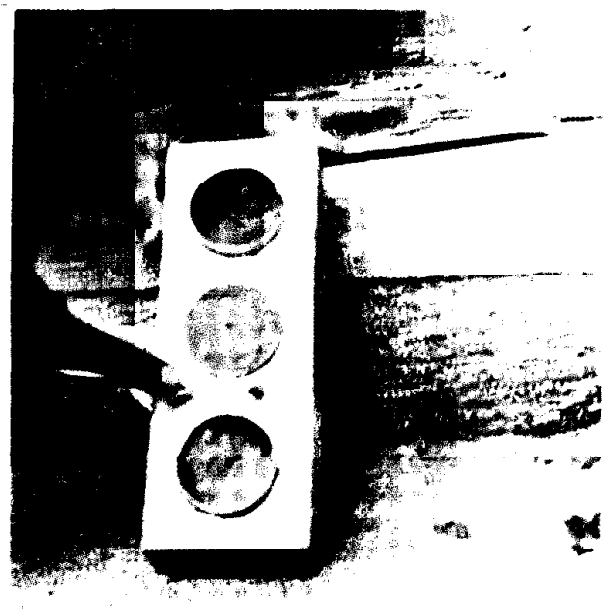


Figure 2. The retained strength of plain sodium silicated core



4% Sodium silicate bonded cores no additives

Figure 3. De-coring property is very low after alaminium casting.

advantages such as:

1) fast cold setting
2) adequate bench life by changing the binder content.
3) Smokeless fumeless casting.
4) Odorless, nontoxic and nonflamable.
5) Dimentional accuracy of the castings

and many others have been reported other by workers [1,2].

In contrast to the above advantages, the retained strength of sodium silicate bonded sand in refusion temperature of the binder is high and in general the plainbinder sand has relatively poor de-coring and collapsing properties [9-11]. It is necessary to add "additives" to the sand mix to improve removal of the cores and moulds from the castings.

Over the years many materials such as coal dust, ground coke, wood flour forms of sugar and pitch have been used [9, 10]. All the above materials, while improving the break-down properties, also cause the problems of reduced strength, storage and bench life [8,9]. On the other hand, most practices were carried out with iron and steel casting [3-10], their high temperature making the cores easier to break. At the same time the temperature of aluminium casting is not high enough to use in this process as well as iron casting. The present paper deals with additives which are used for CO_2 process in aluminium casting.

METHODS

These were performed using Firooz kouh silicate sand (containing more than 96.5% silica) and 4% sodium silicate solution (SiO_2/ NaO_2=2/2) Various additives were used in the amount indicated. Crushed bauxite in the range of 70-90 mesh was the main additive for investigation. Typical composition of bauxite used was as follows:

Al_2O_3	SiO_2	Fe_2O_3	TiO_2	CaO
40.5	35.9	4.9	4.2	0.06

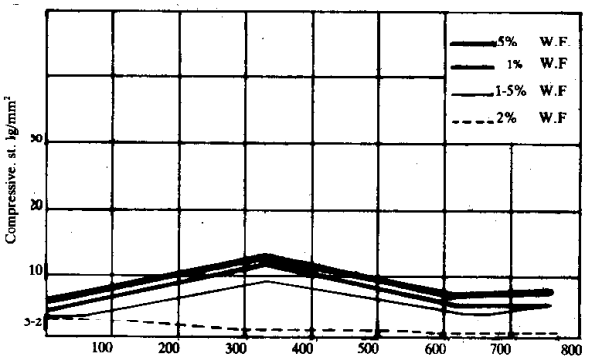


Figure 4. The retained strength of core with different amount of wood - flour

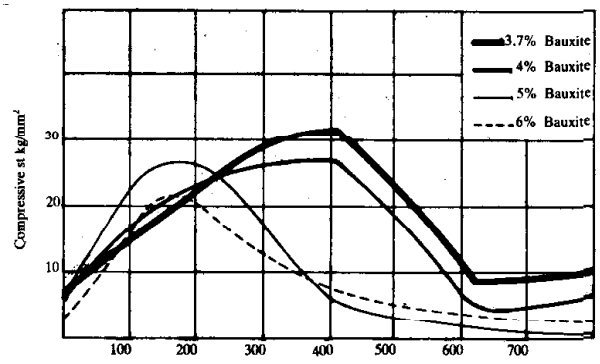


Figure 5. The retained strength of cores with different amount of bauxite

Figure 6. 5% Bauxite additive makes the cores easy to remove.

Sand mixes were prepared in a laboratory mixer. Standard 2×2 inch AFS. 3ram test specimens were prepared with different amounts of various additives. They were gassed with CO_2 at 2kg/cm^2 for 30 sec.

Some specimens (ave. 5 Sp) were tested for compressive strength immediately after gassing. Others were tested in cold condition after being heated to temperatures up to 850 D.C. for 15 minutes.

The casting illustrated in Figure 1 is used to compare collapsibility of cores for aluminium casting alloys. The collapsibilities were examined after cooling the casting by scratching the cores and also by drapping the pieces from a 95 cm height.

RESULTS

A. Plain sodium silicate:

The retained strength of 4% sodium silicate bonded core is shown in Figure 2. Figure 3 shows their high strength after aluminium casting. The drapping test for these specimens showed no de - coring even after 25 times.

B. Wood flour:

The retained strengh of 0.5, 1, 1.5 and 2 percent of wood flour at room temperature after being elevated to the indicated temperature is shown in Figure 4. All specimens had a very low strength after gassing. They were subjected to sand rain and were easily scratched during handling.

C. Bauxite:

The retained comperessive strength of different amounts of bauxite is shown in Figure 5. As the figure indicates the best result for both gassing strength and breakdown is

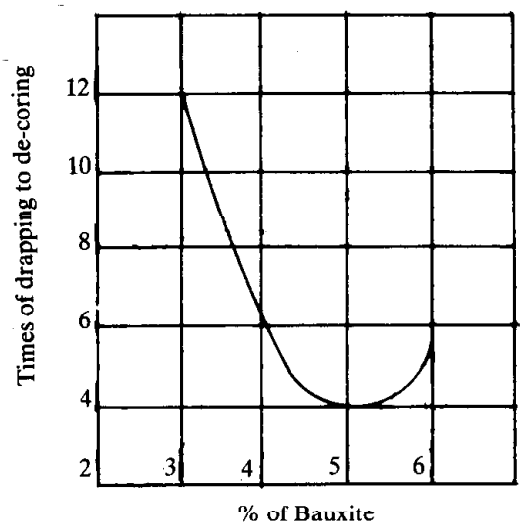


Figure 7-Decoring properties in relation to amount of bauxite.

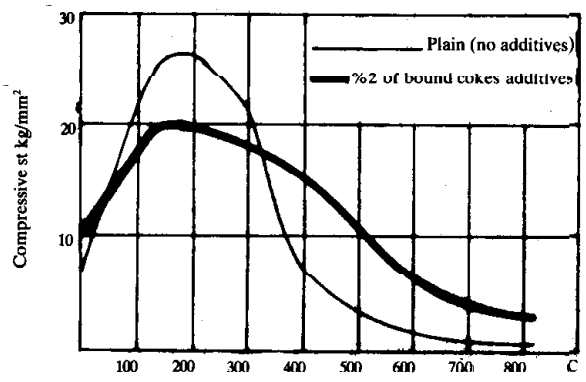


Figure 8- Compressive st at different temperature (2% of g ound coke)

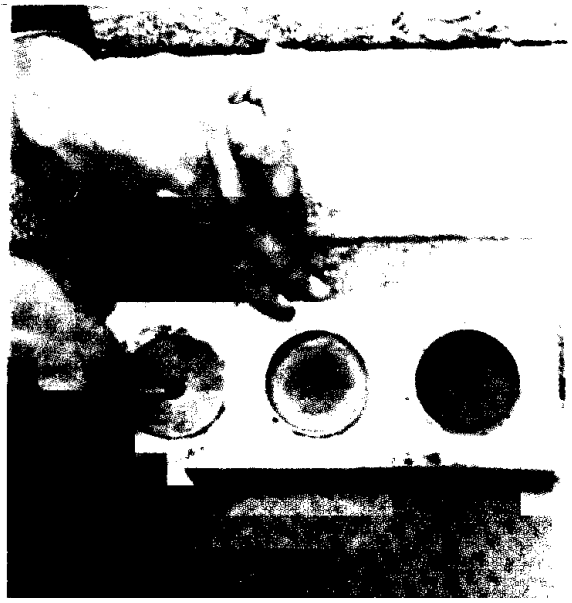


Figure 9.

achieved by 5% bauxite. Figure 6 shows the sand scratching of core with 5% bauxite. Drapping tests also indicate the improved de-coring for 5% bauxite as shown in Figure 7.

In addition to the above results, cores with 2% ground coke which have been reported [8] to improve collapsibility also were tested. The result for different temperatures are shown in Figure 8. Figure 9 shows the scratching results of these specimens which indicate the inadequate collapsibility of these materials for aluminium casting.

DISCUSSION

Consideration of the results indicates that among the various materials, 5% crushed bauxite has less effect on the gas-strength condition of sodiuim silicated cores, while its effect on de-coring in aluminium casting is improved. Gas strengths in comparison with plain sodium silicate reduced by about 40-50% which was quiet acceptable for aluminium casting and the minimum strength was achieved at 800°C. which is less than 3% of plain sodium silicate core at 600°C.

Another beneficial effect of bauxite was that the poor strength which is good for de-

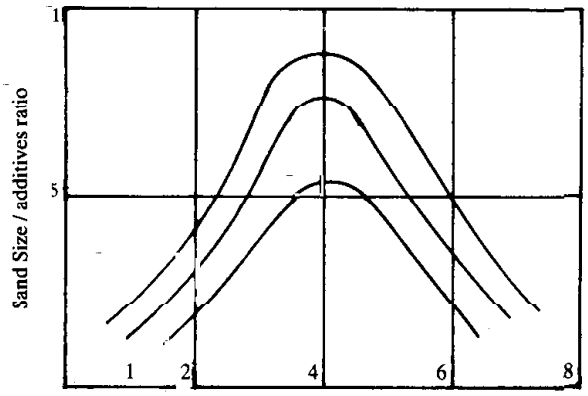


Figure 10. Decoring properties with different size of Bauxite

coring aluminium casting begins at about 350°C and is continiously reduced up to 800°C.

Preliminary works indicate the close relation between sand size and additives (Figure 10). The best results were obtained by sand- additives ratio of about 1.

Practical foundry work could verify the laboratory result which is shown in Figure 11. On the other hand, foundry work can indicate the improved casting surface and also the condition of reused sand which needs more investigation.

REFERENCES

1. Recent Advances in the Technology and Application of silicate Bonded Sand.
R.P. Stanbridge. R. Williams
A.F.S. Trans. V. 87 1979 77 - 90
2. The Carbon Dioxide Process. D.V. Atterton.
A.F.S. Trans. V. 64 1956 14-40
The Silicate Carbon Dioxide Bond - Iron and steel. V.39 1966
3. Part 1 176-180. 4. Part 2 297-300
5. Part 3 331-335. 6. Part 4 523-526.
7. Part 5 V.40 261-264 1967.
8. Molding and Core makinig processes - gas hardened K.B.I. Nicholas BCIRAiFoundry Tech. for the 11-1-11-12
9. Cold Setting Core material Working group P11. British Foundrymen July 1976 147 - 170
10- Why not make it by the CO_2 process.
D.E. Hancox & A.G. Fennel Foundry Tech. for the 16-1-16-14
11. K.E.L. Nicholas. The CO2 Silicate process in foundry BCIRA 1972.