



CAC-Binder Solutions for Reprocessing

Application of CALUCEM – Calcium Aluminate Cements

INTRODUCTION

ISTRA CAC binders are traditionally used in applications such as building chemistry, sewage pipes, refractory mortars and refractory linings. In addition, ISTRA CAC binders can also be used in special applications in the treatment of liquid and solid wastes. For solid wastes, ISTRA CAC binders can be used to consolidate materials in processes where ordinary Portland cement (OPC) is ineffective. In waste water processing, ISTRA CAC binders are used because of the binding effect of the soluble calcium aluminate ions with the undesired constituents.



Figure 1: Labscale briquetting/pavestone device



Figure 2: Briquettes made of ISTRA CAC and waste material

APPLICATIONS

BRIQUETTING OF WASTE MATERIAL FOR REPROCESSING

The iron and steel industry often need to introduce materials such as secondary raw materials or their own filter dust back into their process. Unfortunately these materials may have a very small particle diameter (dusty) or have a high residual moisture (sticky). Compaction, by means of briquetting, is often necessary to handle these difficult materials. ISTRA CAC binders offer an excellent solution for compaction of materials such as mill scale and throat sludge that are not efficiently briquetted with OPC.

Briquetting means the process of binding together pulverized, fibrous or lumpy materials, into briquets, often with the aid of a binder and under high pressure. ISTRA CAC binder and waste materials are mixed with water to reach an earth-moist consistency. The adhesive forces between ISTRA CAC, waste material and water, together with the forming pressure of the briquetting machine (figure 1) provide the green strength of the briquette. After production, the briquettes have to be stored for a certain time to reach their final compressive strength.

ISTRA CAC binders are normal setting but quick hardening Calcium Aluminate Cements with high early strength. They differ substantially from common Calcium Silicate Cements (OPC / Portland Cement), because of their chemical composition and their rapid strength gain. The usage of ISTRA CAC binders may help to increase the throughput of a reprocessing/briquetting plant. With ISTRA CAC binders, waste material compaction can be done even at low temperatures.

ISTRA CAC binders contain Alumina-, Iron- and Calcium-rich minerals. By choosing different ISTRA CAC binders, it is possible to influence the chemical composition of the reprocessed waste material.

ISTRA CAC binders are sulphur- and heavy metal-free. Reprocessing of waste materials with ISTRA CAC binders is therefore possible without any SO₂-emission, meeting environmental and legal requirements accordingly. Figure 2 shows rectangular briquettes made of ISTRA CAC and waste material. The size and shape of briquettes may vary according to local requirements.



Figure 3 shows the compressive strength of ISTRACAC and OPC with the same waste material. The briquette made with the ISTRACAC binder can readily be reintroduced into the process after one day. This is because of the rapid hardening characteristics of our ISTRACAC binders. However, because of the

different hydration mechanism of OPC, the briquette that was made with OPC does not meet the minimum compressive strength requirement of 5 N/mm². It does not have the necessary mechanical strength to allow for reintroduction into the process.

COMPACTION OF WASTE MATERIAL WITH ISTRACAC BINDERS

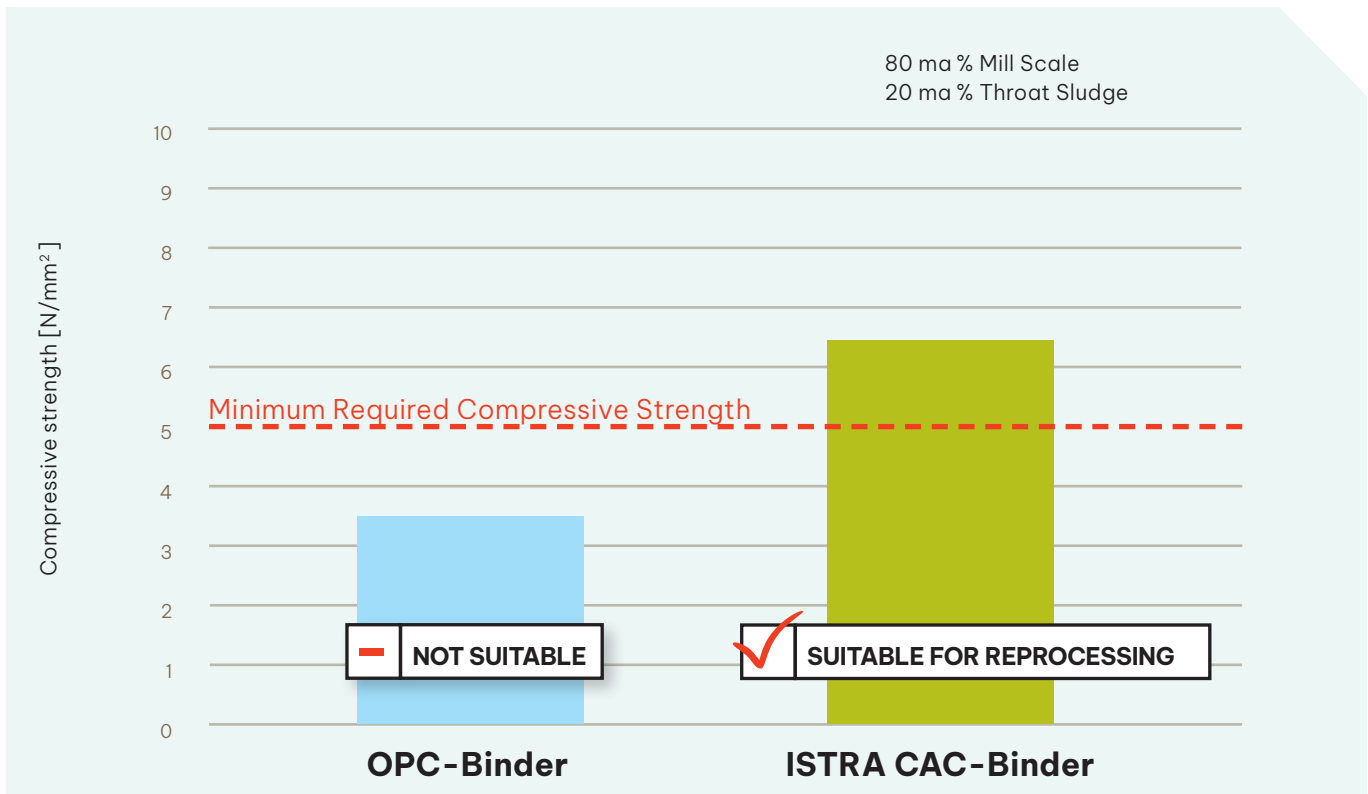


Figure 3: Compressive strength of OPC and ISTRACAC-Binder

An additional benefit of ISTRACAC binders is provided by their chemical composition. ISTRACAC binders mainly consist of four oxides. Iron and steel manufacturers, as well as the mineral fiber industry have a specific demand for the chemical composition of

their secondary raw materials. Thanks to the different chemical compositions of our ISTRACAC's, slag or melt compositions can be adjusted by the right choice from the ISTRACAC product line.

| ISTRACAC Calcium Aluminate Cement Type | Al ₂ O ₃ | CaO | Fe ₂ O ₃ | SiO ₂ |
|--|--------------------------------|-------|--------------------------------|------------------|
| ISTRACAC 40 | 38-42 | 37-40 | 13-17 | ≤ 6 |
| ISTRACAC 45 | ≥ 44 | 37-41 | ≤ 9 | ≤ 9 |
| ISTRACAC 50 | 50-53 | ≥ 40 | ≤ 3 | ≤ 6 |

Table 1: Chemical compositions of ISTRACAC (all data in mass %)

WASTE WATER TREATMENT

Industrial processes can generate a variety of waste water pollutants, some of which are difficult and costly to treat. Waste water characteristics and levels of pollutants vary significantly from one industry to another, and sometimes vary greatly from plant to plant within the same industry. The use of sulfuric acid in battery and fertilizer production as well as in the metal processing and finishing industry can generate waste water with high levels of sulfate. Table 2 summarizes the sulfate content of waste water from different industries.

Environmental laws do not classify sulfate ions as pollutants, but the increased salt content inhibits advanced waste water treatment. Sulfates are of considerable concern because they are indirectly responsible for sewer-corrosion problems. Sulfates are reduced to hydrogen sulfide under anaerobic conditions and lead to sulfuric acid formation (Please see, CALUCEM: "CAC for Sewage Application"). The sulfuric acid corrodes the concrete above the waste water level and leads to a disintegration of the sewage pipe. The concrete corrosion begins at

a sulfate concentration of about 600 mg/l and increases with increasing sulfate content in the waste water. ISTRACAC is able to remove the sulfate ions from the waste water by precipitating the crystalline compound Ettringite ($3 \text{CaO} \times \text{Al}_2\text{O}_3 \times 3(\text{CaSO}_4) \times 32\text{H}_2\text{O}$). Ettringite is a non-hazardous solid that binds the sulfate-ions in its crystalline structure. Ettringite has a low solubility of 5 mg/l. Figure 4 illustrates the general steps for waste treatment with ISTRACAC.

| Industry | SO ₄ ²⁻ -Concentration in mg/l |
|--------------------|--|
| Photo Processing | 100000 - 150000 |
| Glass industry | < 60.000 |
| Mining Waste | ~54000 |
| Metal Treatment | 6000 - 8000 |
| Wire Manufacturing | 4000 - 6000 |
| Battery Factory | 3000-5000 |

Table 2: Sulfate content of waste water from different industries

WASTE WATER CLEANING WITH ISTRACAC

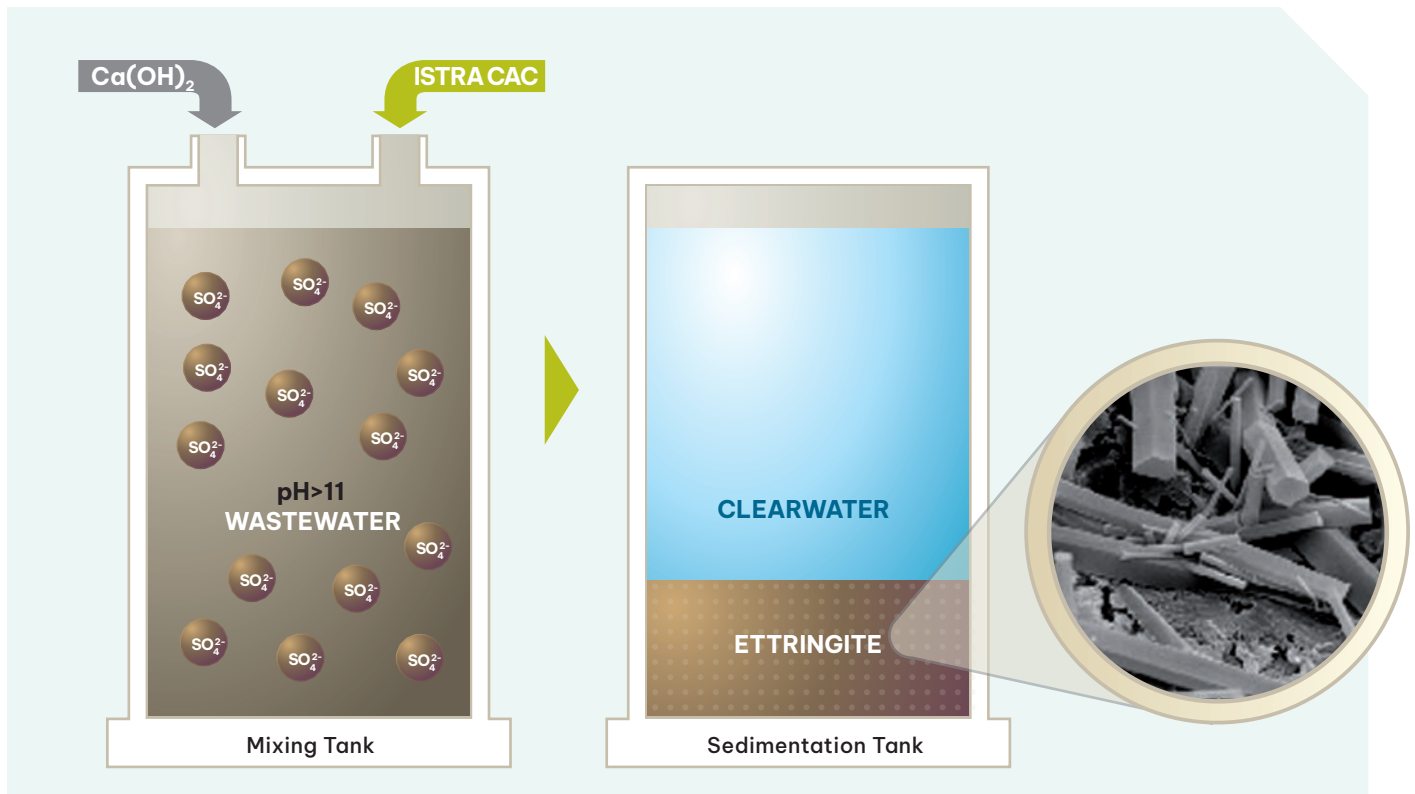


Figure 4: Schematic drawing of waste water cleaning with ISTRACAC

Waste water containing SO₄²⁻ is placed into the mixing tank. ISTRACAC and hydrated lime are added to the waste water. The ISTRACAC that is placed into the waste water creates an excess of Ca²⁺- and Al³⁺-ions. The addition of hydrated lime yields a solution with the pH > 11, the optimum level for Ettringite

precipitation. The precipitated Ettringite is then removed from the settling tank after sedimentation. The sulfate level in the waste water can be reduced to < 600 mg/l after treatment with ISTRACAC.

BENEFITS

Beside the excellent mechanical strength, wear resistance, ease for repair and less downtime, ISTRACAC binders offer unique additional properties in the field of waste treatment:

- Quick Setting and Rapid Hardening c briquetting is possible even with poor waste materials and at low temperatures
- Increased reprocessing throughput due to quick setting and quick hardening
- ISTRACAC binders are Alumina- Iron- and Calcium-rich c Chemical control of solid and liquid waste materials with different ISTRACAC binders
- Sulphur- and heavy metal-free ISTRACAC binder solutions c meeting environmental and legal requirements for process-waste reprocessing.

START FORMULATIONS

We offer customized ISTRACAC binder solutions for different waste materials. Please contact us for individual consultation.

MORE INFO

For additional information about ISTRACAC binders, please visit the CALUCEM web site at www.calucem.com or contact us worldwide.

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