Types of clay for bonding greensand

The clays used to bond silica sand and produce greensand moulds in foundries are known as Montmorillonites (the main constituents of bentonites) with either a calcium or sodium base.

**Sodium bentonites**
Naturally occurring sodium bentonite is generally known as Wyoming or Western bentonite. It occurs mainly in the USA, though it is also found in other parts of the world but in less quantity. It gels rapidly when water is added, and for this reason it is most important that it is added to the mill and not to sand on belts prior to the mill, in order to avoid the formation of lumps. The greensand produced with this clay has medium greenstrength and high dry strength which increases the resistance to erosion by molten metal.

![Graph showing green strength vs. water content for different types of bentonites](image)

Fig. 1 The effect of clay type on the relation of greenstrength to water content, for mixtures based on Chelford 50 sand with 5% clay.

Sodium bentonite clays have good high-temperature durability and the bonding properties are not destroyed by moderate heat.

**Calcium bentonites**
Calcium bentonites are known as Fullers Earths and are widely distributed throughout the world. They do not gel in contact with water, and they produce a moulding-sand having medium greenstrength and low dry strength. Mixtures bonded with calcium bentonites have low resistance to erosion by molten metal and are prone to give scabbing and expansion defects.

**Base-exchanged clay (activated clay)**
Calcium bentonites are capable of 'base exchange'. If sodium carbonate (soda ash) is added to this clay, the calcium base will be replaced by sodium, resulting in a clay that gels with water and has bonding properties approaching those of a natural sodium bentonite. Moulding-sands produced with base-exchanged clays have high greenstrengths, low dry strengths and improved resistance to scabbing and expansion defects.

**Blended or mixed bentonites**
These are commercial blends of sodium bentonite with either a calcium- or a sodium-activated bentonite. Compositions are varied to suit the needs of particular applications. Blended bentonites are often used where high clay levels are necessary to produce strong sands at low moisture contents.

**Greensand properties**
Characteristic curves relating greenstrength and dry strength of greensands with different moisture contents and bonding with various clays are shown in Figs. 1 & 2.

![Graph showing dry strength vs. water content for different types of bentonites](image)

Fig. 2 The effect of clay type on the relation of dry strength to water content, for mixtures based on Chelford 50 sand with 5% clay.

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The effects of varying clay and moisture content on greenstrength, shatter index and dry strength are shown in Figs. 3, 4 & 5 respectively. Fig. 3 shows that the amount of clay used has a marked effect on the greenstrength, which is raised by an increase in the amount of clay used. Figs. 4 & 5 show that the amount of clay used has less effect on the shatter index and dry strength. The Figures also show that increase in moisture content reduces greenstrength for all levels of clay content, but increases the shatter index and dry strength.

**Choice of clay**

For most foundry purposes, it is necessary to produce a sand mixture having high greenstrength and low dry strength, by the minimum use of clay. For this reason, the calcium-based clays are seldom used as a single addition.

![Fig. 3 The effect of increased clay content on greenstrength.](image)

![Fig. 4 The effect of increased clay content on the shatter index.](image)

![Fig. 5 The effect of increased clay content on dry strength.](image)

**Storage of clays**

Clays absorb water from the atmosphere, so they should be stored in dry conditions in silos or bags. At moisture contents above 10 or 12 per cent, clay becomes lumpy and difficult to handle or meter. However, very dry clays can create a dust problem, and require extended milling times to develop good strength. A recent development has been the supply of some clays in granular form, which are then virtually dust-free and provide cleaner working conditions around the mill. Clays do not deteriorate on storage, even for long periods.

**RECOMMENDED FURTHER READING**