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CUSTOMER BASED REQUIREMENTS AS RULING LIMESTONE AND LIME PRODUCTION

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Limestone is an industrial mineral with a wide range of uses in production of products that are important in our daily life. Limestone can be used as such or it can be the raw material for quick lime and hydrated lime. Lime plays a role in producing our daily newspaper, in glassware, steel products, in agriculture when growing the crops, in drinking and waste water treatment and so on. Different quality requirements are important depending on the function of the lime product during the production process.

Modern process industry put constantly increasing quality requirements on raw materials. The requirements are based on efficiency, quality and environmental measures and of course cost factors. This is true for the whole chain of processing and is finally ruled by the end customer who actually decide what quality he wants to consume and what he is willing to pay for the product.

Globally acting companies introduce similar requirements and quality measures in all markets they enter. Increasing competition force industry to use optimal and most suitable raw materials for each purpose.

Important properties of lime products:

- chemical purity
- reactivity
- colour or brightness
- processing behaviour (thermal)

Looking at these properties we can evaluate some applications where lime products are used and what requirements there is.

Chemical purity

A general aspect concerning all process industry is that the better quality limestone or quick lime they can get as raw material input the higher their process efficiency will be. A pure raw material is in many cases a cost factor. It plays a significant role if quick lime contains 70 or 90 % available CaO. In most cases this is more depending on used lime burning technique than the quality of limestone feed.

Steel industry uses both limestone and quick lime in their process. Important parameters are silica and sulphur content. Silica is removed from iron ore in steel processing and it is undesirable to get it into the process with some raw material as it will consume energy in the process. Sulphur is also removed in the steel process and additions from input material is not welcome.

Modern pulp mills are closing their cycle of chemicals and sometimes silica and aluminium is considered to be a problem if it accumulates in the process. Amount of soluble elements varies in different limestone sources.

Lime products are used in drinking water treatment for pH adjustment and in this case it is of importance not to add any harmful heavy metals into the water.

In glass production high iron content affects the colour of the glass which is of importance when producing white glass.

A different kind of chemical purity is the calcium and magnesia relation in limestone or the degree of dolomitization. In agriculture, improvement of soil may need addition of calcium or magnesia depending on the soil conditions. High content of magnesia in a dolomitic limestone may possess a good market value.

In building material products magnesia is in general to be considered as an impurity especially when quick lime is produced. High magnesia content will cause late hydration and if this happens in a brick or wall construction, cracking may be the consequence.

Brightness

Carbonate based paper pigments are constantly increasing their share on the market. Brightness is the key parameter in these pigments. Carbonate pigments are divided into two main products that are: GCC or Ground calcium carbonate and PCC pr Precipitated calcium carbonate.

GCC is finely ground limestone and PCC is produced from quick lime by slaking it and carbonating it back to calcium carbonate. In GCC the limestone in it self need to be of high brightness to produce a quality product. Marble seems to be the solution. Because of PCC production process the colour of limestone is not the ruling factor but rather the amount of elements like magnesia, iron and manganese that may take a place in the crystal lattice of the final product.

In the building material segment plaster and mortar products also demands increasing brightness as white products are requested by the market. Marble is here also the answer for a suitable raw material.

Reactivity

Reactivity is related to surface area of the material. In limestone high porosity increases the available surface and reactivity. In the processed product, for instance a powder, the degree of grinding also increases the surface area.

The most common measure of reactivity of quick lime is the wet slaking reactivity. A certain amount of lime is mixed with water and the temperature increase of the following exotermic reaction is measured. The original properties of the limestone has an influence of this reactivity but to a very high degree it is also affected by the burning process. Different types of lime kilns produce quick lime of varying reactivity. A rough division is that long rotary kilns produce lime of low reactivity and shaft kilns produce high reactive lime.

In some processes high reactivity may be beneficial from productivity point of view. Slaking proceeds faster and the passage time will be shorter.

Pulp mills add external, fresh or so called make up lime to their process continuously and from time to time their lime mud kilns may break down and they have to compensate for all lime externally. It is a clear advantage if to reactivity of the external lime is as much like their own lime as possible.

Coal fired power plants and waste incineration plants release sulphur if they aren't equipped with some kind of cleaning unit for the flue gases. There are many different techniques available and depending on the type, limestone, quick lime or hydrated lime may be used as absorbent. A limestone with as high calcium content as possible must be used to get the most possible reactive matter into the cleaning process. Porosity and available surface area is one of the parameters ruling the limestone properties in this aspect.

Processing behaviour of limestone

A big portion of all quarried limestone is used as feed for lime kilns. The kiln technique in it self affects the result but the limestone also plays a basic role here. Coarse crystalline metamorphic marble type limestone decrepit in the burning process and produce small particulate quick lime. To guarantee even burning conditions limestone feed into kiln must not be too wide. If the limestone falls apart in the kiln it will cause overburning and reduced reactivity of fine particles and a raw burning of coarse material. Young sedimentary type of limestone may produce a lump lime where particle size of product is quite close to feed size. Also this type of limestone behaves differently depending on case and some limestone produce a very soft quick lime. Feeding of a soft quick lime into the steel process for instance, with strong and turbulent air flow will cause great losses of fines material and hence low degree of utilization.

High magnesia content in limestone will cause an uneven quick lime quality as the dolomitic part calcines in a lower temperature than the calcitic part.

All of the above mentioned properties and others, force limestone and lime producers to adjust the choice of raw material to customer requirements. It is not always possible to meet all customer requirements from one deposit of limestone.

In some cases norms and standards approved by authorities regulate the quality for different uses. However customer specific requirements are more and more common and product quality has to meet both the needs of the end usage and cost efficiency aspects in the next process step.

Very few limestone deposits are homogeneous in all dimensions. Sedimentary deposits show great variations between different geological layers and a metamorphic deposit may have very complex folded and faulted structures and inclusions of wall rock and cutting dikes. To produce an even quality product out of such deposits in most cases involves selective mining methods or even some kind of sorting step. Control of mine balance between different qualities becomes critical for the quarry operation.

Quality assurance systems include drillings and chemical analysis prior to quarrying and blasting in order to control stone quality variations and to keep them separated. Chemical analysis must also be done along the production chain to create confidence in what quality is shipped to customer.

Quality variations of a natural geological raw material cannot be changed but it can be processed in a controlled manner in relation to specifications defined by the customer.