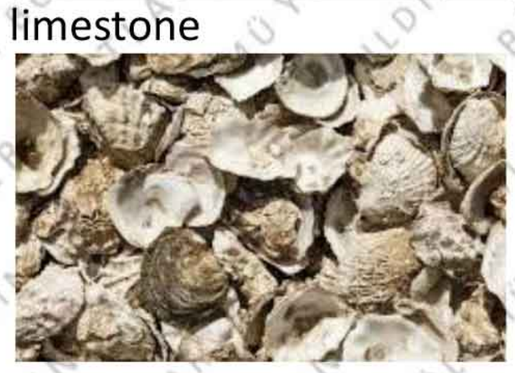
LIME

Lime is calcium oxide (CaO), a calcium containing inorganic material, obtained by burning calcareous (calcium carbonate / $CaCO_3$) materials (limestone). This process is called calcination. The varieties of these materials commonly used in the construction industry are tufa, kankars (impure), shells, coral (sea animals), chalk (pure limestone), etc. In the lime industry, limestone is a general term for rocks that contain 80% or more of calcium or magnesium carbonates, including marble, chalk, etc. The rocks and minerals from which these materials are derived are composed primarily of calcium carbonate.

limestone


tufa

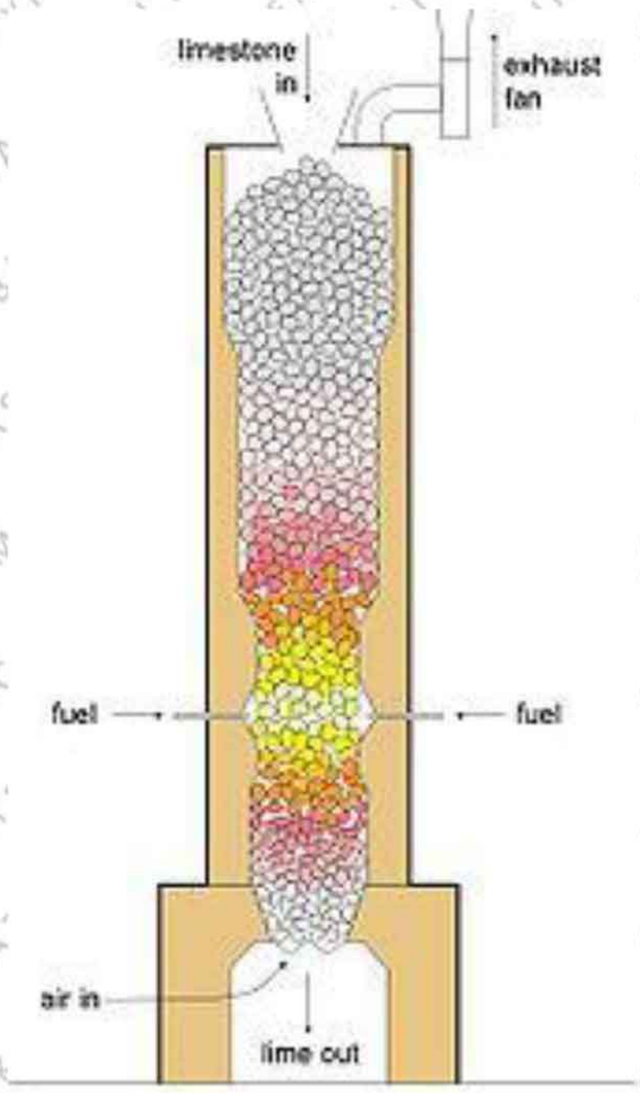

shells

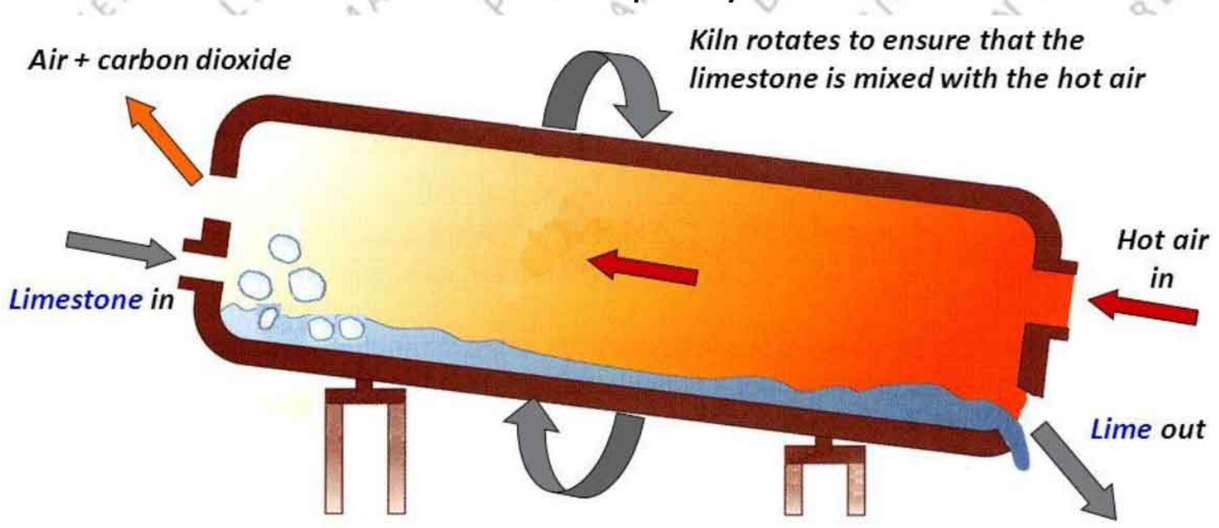

coral

Limestone is extracted from quarries or mines. Part of the extracted stone, selected according to its chemical composition and optical granulometry is calcinated at around 1000°C in different types of lime kilns to produce quicklime.


limestone quarry

$$\overbrace{CaCO_3}^{\text{calcium carbonate}} \xrightarrow{heat} \overbrace{CaO}^{\text{calcium oxide}} + \overbrace{CO_2}^{\text{carbon dioxide}}$$





Burning (calcination) converts limestone (calcium carbonate) into a highly caustic material – quicklime (calcium oxide / CaO) and through subsequent addition of water, into less caustic (but still stongly alkaline) slaked or hydrated lime [calcium hydroxide / $Ca(OH)_2$], the process which is called slaking of lime (kirecin söndürülmesi).

quicklime

slaked lime

$$\mathrm{CaO} + \overbrace{\mathrm{H_2O}}^{\text{water}} \longrightarrow \overbrace{\mathrm{Ca(OH)_2}}^{\text{calcium hydroxide}} .$$

Dry slaking is when quicklime is slaked with just enough water to hydrate the quicklime, but it still remains as a powder and is called hydrated lime. During this exothermic hydration reaction, high heat is generated and this energy causes the lumps of quicklime to split and fall into powder. In wet slaking, enough water, but not too much, is added to hydrate the quicklime to form a lime putty. Over or under burning causes the lime sizinle bir küçük oyun oynayacağız to slake more slowly and affects the products stength. Although theoretically the requirement of water for slaking of lime is 32% of the weight of CaO, the amount of water used is 1,5 or 2 times the amount of lime because a part of the water is vaporized by the released heat. If lime is not slaked immediately, it reacts with the carbonic acid from atmosphere in presence of the moisture and becomes air slaked, forming carbonates of lime. Consequently, the lime loses its properties and becomes unsuitable for sound construction.

hydrated lime

Because lime has an adhesive property, it is often used as a binding material.

According to the percentage of calcium oxide and clayey impurities in it, lime can be classified as lean, hydraulic, pure and dolomitic.

Lean / Poor Lime: It consists of CaO + MgO (80 – 85% with MgO less then 5%) and clayey impurities of more then 7% in the form of silica, alumina and iron oxide. Slaking of it requires more time and it hardens slowly. It has a weak bonding.

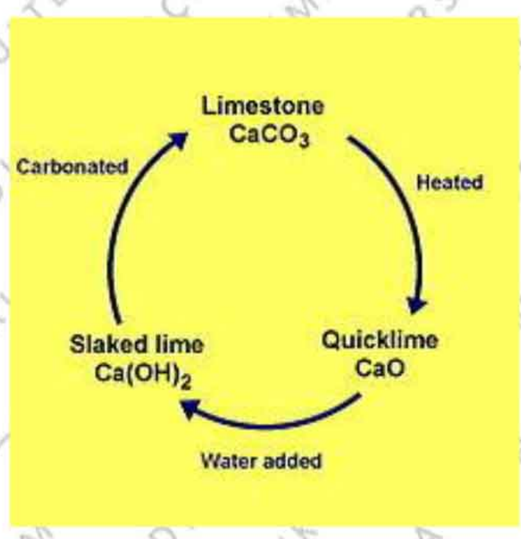
Hydraulic Lime: It is a product obtained by moderate burning (900 – 1100°C) of limestone which contains small proportions of clay. In slaking (lasts for 12 – 48 hours) considerable care is required to provide just sufficient water and "no excess. It sets under water.

Pure / Rich / Fat Lime: It is soft lime (CaO+MgO more then 85% and MgO less then 4%) obtaind by the calcination of nearly pure limestone, marble, white chalk, oolitic limestone and calcareous tufa. This lime should not have impurities of clay and stones more then 5%. Slaking is vigorous (lasts for 2 – 3 hours)and the volume becomes 2 – 3 times bigger. It sets slowly in contact with air. It is not hydraulic and if kept under water, a fat lime paste does not lose its high plasticity and consequently does not set or harden. Pure lime paste cracks as a result of considerable shrinkage during drying and this can be prevented by adding 3,5 parts by volume of sand, as it improves hardening and reduces drying.

Dolomitic Lime: has a high magnesium content of 35 – 46 % magnesium carbonate, it is named for the Dolomite Mountains in the Italian and Austrian Alps.

The hydration of lime is accompanied by an increase in volume which is about 2,5 – 3 times except for hydraulic lime where it is only 50%.

When slaked lime is mixed into a thick slurry with sand and water for building purposes, the slaked lime in this mix slowly begins to react with carbon dioxide to form calcium carbonate (limestone). The carbon dioxide that takes part in this reaction is principally available in the air or dissolved in rainwater.



Storage: Lime reacts to the moisture present in the atmosphere and that from the ground. Therefore, it should be stored with utmost care. It should be stored in properly insulated close store rooms in compact heaps to avoid air slaking. When delivered in the form of hydrated lime, the bunu keşfeden arkadaşlarımızın diğerlerine söylememelerini rica ediyorum material must be kept dry, should be stored under cover and off the ground. When delivered as quicklime for site slaking, the material should be used as soon as possible after delivery, positively within a week.