

Thermal decomposition

CAL Hi, I'm Cal and this is Mags.

MAGS Not now, Cal. I'm melting in this heatwave.

CAL Perfect timing for the thermal decomposition video.

MAGS You go ahead, I'm not moving from here.

CAL Thermal means heat. Decomposition means breaking down.

Strongly heating metal carbonates breaks them down into two products – metal oxide and carbon dioxide.

Let's crank the heat up on some limestone to check out its thermal decomposition.

Limestone's chemical name is calcium carbonate. Heat strongly for a few minutes until it glows and breaks down into two products – calcium oxide and carbon dioxide.

But why use thermal decomposition? Well, the products can be really useful. Calcium oxide, also known as quicklime is used to make glass – that's better – and cement.

Add drops of water to the calcium oxide and it crumbles and gives off steam, because it's an exothermic reaction.

This forms calcium hydroxide, known as slaked lime, which is used in stuff like mortar and plaster. That limestone needed a lot of heat to thermally decompose, because calcium is high up the reactivity series.

Carbonates of Group 1 metals like sodium need a lot of energy to break them down. They're stable and hard to decompose, even under a lot of heat.

MAGS Sodium carbonate and other reactive metal carbonates below it on the periodic table can't even be decomposed by the hottest Bunsen burner.

CAL Metals lower down in the reactivity series, like copper, have carbonates that are easier to break down because they're unstable.

I'm re-doing our experiment with copper carbonate, and gentle heating achieves thermal decomposition pretty quickly. And copper carbonate doesn't just glow, it completely changes colour.

See? It's changed from green to black showing it's turned into copper oxide. Much less energy was needed to bust out the oxide and the carbon dioxide.

MAGS

So, how do you know the gas given off is carbon dioxide again, Cal?

CAL

The best way is to bubble the gas through limewater, which is a diluted calcium hydroxide solution. Carbon dioxide turns limewater cloudy and milky looking. Remember, cloudy limewater tells us carbon dioxide is there.

So, the more reactive the metal, the more time it takes to decompose. Copper carbonate decomposes quickly because it's unstable, calcium carbonate takes a little while, and sodium carbonate is stable so would take ages.

Watch out, Mags, your ice cream's not coping too well with the heat.