

## LIME SCALE AND SYSTEM CORROSION (SLUDGE)

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### Lime scale

When water is heated, naturally occurring calcium or magnesium carbonate is deposited in the form of lime scale. The higher the temporary water hardness the higher the alkalinity of the water, and the higher the temperature the water is heated to, the more scale will be deposited.

### System Corrosion (Sludge)

Sludge forms in all untreated systems when an electrolytic reaction occurs. This happens when two dissimilar metals carry a different electrical charge; but basically the radiators and boiler are rotting away. Reddy brown water and deposits (ferrous oxide) are caused by air entering the system. It can enter in various ways; micro leaks on joints, badly designed pipe work layouts, or by frequent intake of fresh oxygenated water. It is often a sign of active corrosion. Black magnetite sludge (ferric oxide) forms dense sediments in the radiators and boiler. It clogs pumps and reduces the flow of water through pipes and radiators. It is often a result of a system not having been flushed out correctly after installation. Black water that can be drawn from a radiator air bleed, boiler bleed or drain cock is usually a sign of an advanced state of corrosion. Black oxide is formed in all untreated heating systems. Clear water does not always indicate a clean system as the sludge can actually fuse itself to metal surfaces within the system. One of the by-products of corrosion is the production of hydrogen gas. If regular "gassing" of a heating system occurs (what appears to be air in radiators), great care should be taken as hydrogen gas is highly flammable.

If Lime scale or Sludge forms in the heat exchanger it can produce an insulated coating or "mass" which can have differing effects.

1. The heat the boiler produces can't get into the water jacket as easily and so ends up leaving through the flue, thus increasing fuel consumption as well as potentially damaging flues and flue seals due to higher flue temperatures.
2. The insulated coating can shield the boiler control stat leading to inaccurate temperature control.
3. The scale or sludge may continue to heat the water after the appliance reaches temperature, raising the temperature further and can cause what is known as localised boiling; this may activate pump overrun protection, trip overheat thermostats or just produce banging, gurgling or other strange noises from the water jacket.

Other symptoms of Sludge are: Less heat or higher fuel bills, failure of circulating pumps, sticking motorised or TRV's, cold spots in the radiators, leaking boilers or radiators or joints on the pipework to them, failure of pressure gauges, AAV's and PRV's or what may appear to be the failure or inaccuracy of boiler control thermostats.

1mm of scale can increase fuel consumption by 7.5%, while a 12mm layer can raise this figure to 70%. Flushing with water only removes about 10% of the debris in a system; add a power flush and you can expect to remove up to 30%. By using chemicals and a power flush you can remove around 80%. Even if using a power flush machine, the best way to achieve maximum effect is to drain the system first, which ensures most sludge that was held in suspension of the water is removed, this then allows the chemicals to have maximum effect on sludge that has deposited on internal surfaces of boilers, radiators and pipe work, when added during the re-filling process.

If using Sentinel X400 High Performance Cleaner, small systems of up to 50,000 Btu's containing up to 100 Litres of water are usually treated with a 1% dilution i.e. 1 bottle of High performance cleaner; larger systems of up to 100,000 Btu's or 200 Litres of water would need to be treated with a 2% dilution (up to 4 bottles). The water should be circulated at full temperature with all radiator valves fully open for a minimum period of 2 hours or until satisfactory performance is restored before using the Power Flush pump. If the system is heavily fouled then a double dose may be required and left to circulate for 3-4 weeks before the Power Flush takes place (up to 8 bottles). Systems that are classed as Storage Combi or those using a Thermal Store instead of an Indirect Hot Water Cylinder would need to be treated with the correct dose rate as determined by the increased system volume that they have. Other manufacturers treatments may have differing periods for the maximum time the chemical can remain in the system. Additional Sludge removal chemicals and additional Power Flushing may need to be repeated in some cases.

Once the system is clean it must then be dosed with Corrosion Inhibitor, which is a substance that when added to the system reduces the rate at which corrosion takes place. In simple terms Corrosion inhibitors form a very thin film between the metal and the water to try to prevent corrosion taking place. The film is only maintained by the continued presence of inhibitor in the water. Systems require a sufficient dose to "coat" the internal surfaces of the system plus some excess to maintain this film. If there is an air pocket in the boiler, pipework or radiators unprotected exposed areas of metal will continue to corrode whether there is sufficient corrosion inhibitor in the system or not. Overdosing with inhibitor is unlikely to have any detrimental effect, but under dosing can. For corrosion inhibitor to work the system must be clean; it cannot work in a fouled system. Installers can now fit a Magnetic filter which will attract Sludge particles, and help maintain a healthy and efficient system; but they are not used instead of correct system cleaning!