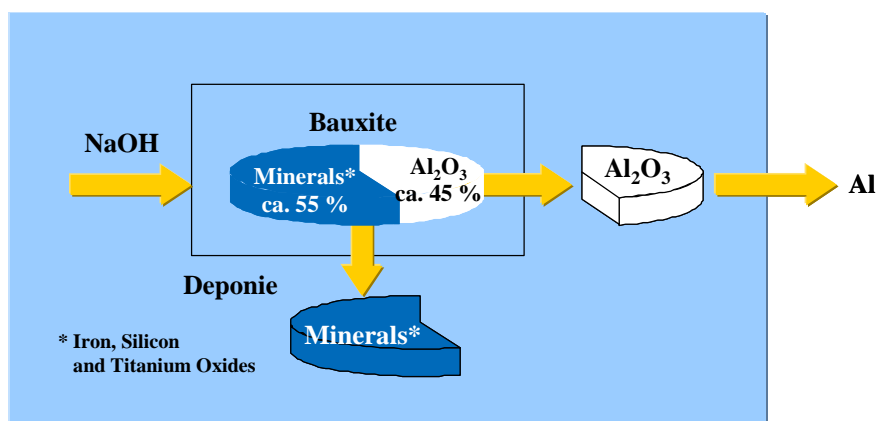


## Red mud and red mud disposal sites

Bauxite is an ore with a high concentration of aluminium compounds. This high aluminium content makes bauxite a useful raw material for the extraction of aluminium. To produce primary aluminium, the aluminium compounds in the bauxite are first dissolved chemically, using caustic soda, in an alumina refinery. This produces aluminium oxide. Red mud, which is a slurry containing natural substances originally present in the bauxite - i. e. the ore residues with a residual amount of alkali - is left over from the process. The high concentration of iron compounds gives the waste product its characteristic red colour. The amount of red mud produced depends on the aluminium content of the bauxite. Bauxite ores with a high aluminium content result in lower ore residues than bauxite ores with a lower aluminium content (**Fig. 1**).

*Fig. 1: Aluminium oxide is dissolved out of the bauxite and processed further to aluminium. The residue containing a mixture of naturally occurring minerals is then transferred to a disposal site.*



The red mud is then disposed of at a special holding site. By maximising the separation of the caustic soda

from the ore residues, one achieves the optimal conditions for disposal. This is also beneficial in two ways:

- The caustic soda can be recycled as part of an efficient closed-loop system.
- Apart from remaining traces of alkali, the ore residues do not contain any industrial additives.

Thus, red mud is not hazardous waste and can be disposed of in an environmentally neutral manner.

In Germany, the mud is pumped through pipes to the plant's own disposal site, where it is stored. Any caustic soda left behind after sedimentation is directed back to the production process. Natural impervious layers act as a seal for the disposal site to prevent seepage. Groundwater wells are used for control purposes and samples are taken several times a year to check whether any substances from the disposal site have entered the ground-water. Rain-water is pumped off and fed into a wastewater treatment plant.

Domestic production cannot satisfy the demand for alumina in Germany

and therefore it also has to be imported. Jamaica is Germany's most important alumina supplier, accounting for over 50 percent, and it is also the world's fourth largest producer.



*Fig. 2: Caustic soda collection*

In Jamaica, the ore residues are separated from the caustic soda. The caustic soda is recycled. The disposal sites have natural impervious layers that act as a seal to prevent seepage. In new processes, a binder is added to the red mud at the alumina plant in order to accelerate de-watering and drying, and to bring about solidification as quickly as possible. Thanks to the tropical climate in Jamaica, the drying process occurs relatively quickly. The caustic soda is collected at points lower down at the disposal site and fed into basins (**Fig. 2**). The liquor is used again in the alumina plant to leach out the red mud. Samples of surface and ground-water are regularly taken from near the alumina plant and red mud disposal sites and checked to measure their pH along with their sodium, calcium and chloride contents.

Once their storage capacities have been exhausted, red mud disposal sites can be reclaimed. This requires pre-treating the red mud with e.g. gypsum, to lower the pH of the disposal site. A layer of top-soil is required to turn the site into grazing land.

It is also possible to reclaim red mud disposal sites without using top-soil if selected types of grasses are used. In such cases, research projects are carried out and plants from various sources are investigated in test areas to evaluate their suitability for the intended application (**Fig. 3**).



*Fig. 3: Test areas for land reclamation without the use of top-soil*

Red mud consists of naturally occurring residues from the bauxite ore along with traces of residual alkalinity. Red mud can therefore be disposed of at holding sites - even in accordance with the stringent requirements of German legislation. The caustic soda is recycled as part of an efficient closed-loop system. Red mud disposal sites can be rehabilitated in accordance with local climatic conditions.