Cement production is an energy-intensive process, which traditionally has been dependent on fossil fuels. However, the use of alternative fuels, i.e., selected waste, biomass, and byproducts with recoverable calorific value, is constantly increasing. Combustion of these fuels is more challenging, compared to fossil fuels, because of a lack of experience and different chemical and physical properties. When complete oxidation of fuels in the calciner and main burner is not achieved, they burn in direct contact with the bed material of the rotary kiln, causing local reducing conditions and increasing the internal circulation of S, Cl, Na, and K. Compounds containing these elements, such as alkali salts, evaporate when exposed to high temperatures and subsequently condense in colder parts of the plant. The transformation of the volatile inorganic species at different locations in the cement plant is important, because a high internal circulation affects the process stability and operation through formation of buildups and blockages, ring formation, and shell corrosion, resulting in reduced clinker production, higher heat consumption, and kiln or plant stops. The present review describes the internal cycles of inorganic elements that are established within the cement plant and their dependence on process parameters. Special focus is given to the sulfur cycle. This cycle is intensified by CaSO4 decomposition, making it sensitive to local reducing conditions.