As a result of ever increasing quality demands from the market, desulphurization of hot metal in the steelmaking process is inevitable. Currently various methods are used to desulphurize the hot metal. The main focus of this article is on the Kanbara Reactor (KR) process (using only lime as a reagent), the Magnesium mono-injection process (using only magnesium as a reagent; also known as the Ukraina Desmag process) and the co-injection process (using magnesium and lime/CaC$_2$ as reagents). These three desulphurization methods are studied based on metallurgy, performance and operational costs.

Due to the equilibrium of dissolved sulphur in the hot metal and sulphur in the slag, a calcium based reagent (like lime) is essential when stable low sulphur concentrations in the steel are to be reached. This is a major drawback for mono-injection of magnesium, which needs to either add a calcium containing material to the slag or “undershoot” to compensate for the high sulphur content later in the steel plant.

Magnesium is a much faster desulphurizing agent than lime, about twenty times faster. This means that for fast desulphurization of hot metal, magnesium is required or large quantities of lime. Therefore the KR process is only an option if the hot metal desulphurization is not a bottleneck in the process. Co-injection has the advantage that its speed can be altered by changing the injection ratio between magnesium and lime.

Due to the harsh environment of any desulphurization system, reliability and robustness of the system is an issue in steel plants. The wear and corrosion for the three desulphurization processes however differ, since the reagents, their quantities and the flow regime in the hot metal are different. The KR process has more problems with wear and corrosion, due to the impellor lance, than co-injection or magnesium mono-injection.

Eventually the best desulphurization process for a steel plant is the one that reaches its targets the most consistently and at the lowest costs. This includes not only primary costs like reagent costs, costs for equipment repair and consumables, but also production loss due to delays, temperature loss and costs for repairing too high sulphur contents later in the process. KR has the lowest
costs when considering only reagent prices. However the biggest factor in the economical comparison for desulphurization processes is the iron loss in the skimmed slag. Therefore slag composition and quantity is of major influence on the total costs. This factor makes KR more expensive than co-injection and magnesium mono-injection, since more slag is created.

In the end it depends on the circumstances in the steel plant which desulphurization process is the best option. In practice it turns out that co-injection is the most cost efficient option for the majority of the steel plants, since it combines the best of both worlds. Therefore co-injection is still worldwide viewed as the standard practice.