The Potential of Hydrogen for Decarbonization: Reducing Emissions in Iron and Steel Production

CLIMATE change is one of the biggest global challenges that we are tackling today. While a lot is being said and done, it is only recently that the potential of hydrogen was identified in reducing emissions during iron and steel production.

A little insight into the contribution of the iron and steel industry to the global warming crisis. Producing steel and iron emits around seven percent of the total green house gases on the Earth. This is a big number. While few researches and policies have made an impact in reducing these greenhouse emissions, they are yet to make a dent in the reduction effort.

A tangible effort in the form of replacing coke with hydrogen in a blast furnace as a reducing agent can help reduce these emissions. Instead of coke, the hydrogen produced from electrolysis of water has the potential to reduce emissions substantially and decrease the carbon footprint left by the iron and steel industry. Carbon capture and storage (CCS) process can directly be used at a steel plant or for the production of hydrogen.

Other options include:

- Efficiency increase of current steel and iron production methodologies.
- Recycling the steel. However, the process cannot rule out impurities, like copper particles that can accumulate on the surface over time.

The Iron and Steel Manufacturing Process

Some of the most common iron and steel manufacturing processes are BF-BOF with carbon capture and storage (CCS), direct reduction of iron ore (DRI) with CCS, electrowinning (electrolysis of iron ore), and green hydrogen-based DRI production. While all have their respective merit towards the cause, the logistics in case of the CSS process proves it to be an expensive process.

Dr. Malini Saba

The hydrogen direct reduction of iron ore - the process on which many steel production plans rely on, is one of best alternatives to the much popular BF-BOF method. The production of hydrogen in the Hydrogen Direct Reduction of Iron ore (DRI), complete with the reinforcements by renewable energy generators offer an added advantage of taking the load off the electricity grid.
The release of energy, as portrayed by the equation above demonstrates an endothermic reaction where the reduction of iron ore and production of water that when later undergoes electrolysis, produces hydrogen.

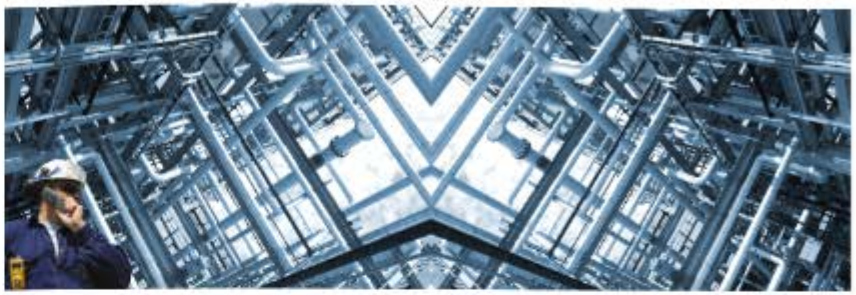
Changing to a hydrogen-just framework altogether changes this thermodynamic equilibrium, so the

In this system, the DRI is directly placed in EAF for the iron and steel production and can be presented in the form of the equation

$$3\,Fe_2O_3(s) + H_2(g) \rightarrow 2\,Fe_3O_4(s) + H_2O(g)$$

$$(1-x)Fe_3O_4(s) + (1-4x)H_2(g) \rightarrow 3\,Fe_{1-x}O(s) + (1-4x)H_2O(g)$$

$$Fe_{1-x}O(s) + H_2(g) \rightarrow (1-x)Fe(s) + H_2O(g)$$



hydrogen should be preheated before it enters the heater,.

Hydrogen Derived from Electrolysis

Steelmakers have found this idea appealing for a long time but this idea has many takers now more than ever! With the rising awareness with respect to sustainability, this option is now being considered by many industry players. Of the few different ways hydrogen can be created, environmentally friendly power coupled to electrolysis ought to be the need as it accomplishes the biggest outflow cuts, ±21% coming about because of hydrogen use in the BF-BOF.

Grey Hydrogen - Hydrogen from Reformative Natural Gas

If hydrogenation is done using electricity to split water into oxygen and hydrogen, electricity created from green sources, it is called green hydrogen while non-renewable resources produce grey hydrogen. A few organizations say they will utilize green hydrogen when accessible at sensible expenses and amounts, a case repeated by numerous individuals in different businesses. Under current arrangement structures the date for these conditions to be satisfied is obscure, yet probably not going to be in the close term. Meanwhile, they'll utilize grey hydrogen.

The Plant of Doubt

While there are significant advantages to hydrogen decarbonization, many scientists think that using recyclable resources directly might be more economical than hydrogen to dial down on the iron oxides residue.

Final Overview

Hydrogen is bound to improve the clean energy agenda, however, at the current cost, the replacement might raise the cost of one ton of steel by one-third. However, this gap will be reduced by 2030.

Moreover, producing the required amount of hydrogen for decarbonization of the steel and iron industry would require 20% in electricity that would further encourage the expansion of the renewable resources. This might be a good thing because it can create a chain reaction of sustainability that would, further down the road improve the demand for solar and hydro energy to be specific.

Dr. Malini Saba is self-made Businesswomen and the founder & chairman of Saba Group. 'Saba Group' is a privately-held company that employs over 5,000 people, operates in more than 20 countries and comprises 15 companies across 10 verticals. The group has an affinity towards commodities and trades in the business of rice, steel and has a strong foothold in pharmaceuticals and Fin-tech business. It also operates in gold mining, entertainment, real-estate, hospitality sectors and does impact technology investments all over the world.

TABLE OF CONTENTS

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