"***The role of engineering and new technologies in metallurgy operations***"

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Materials processing operations produce a considerable amount of the CO2 emissions generated by the manufacturing sector. About a third of man-made global CO2 emissions, which equate to about two thirds of all CO2 emissions, are from Industry so roughly 22%. In 2017 and about 1/3 of this came from the production of steel at 3.7 Gt CO2/year.

Steel made using current production techniques has a carbon intensity of about 2 t CO2/t and an energy intensity of about 22 GJ/t and aluminium has a CO2 intensity of about 14 t CO2/t and energy intensity of about 211 GJ/t. For steel production we are still using a 300-year-old process combined with a process patented in 1856 to produce steel. There is a new technology that can be used to produce steel that reduces the CO intensity to almost zero. the direct reduction process – using hydrogen. However vested interests in the industry and a lack of political drive has held up the change of the technology because of huge capital investment involved in changing from one technology to another for a materials that is produced in volumes of 2 Bt globally per annum. Aluminium production, the next largest metal volume produced at about 60 Mt, is growing rapidly as "lightweighting" becomes the mantra of transportation engineers - it has trebled in the last 40 years. About 25% of the CO2 emissions for primary aluminium production are from the consumable carbon electrodes if non-renewable electricity sources are used, which is the case for nearly 75% of the tonnage. New technologies of inert anodes which do not produce CO2 have been developed by Rio Tinto but this is at an early stage. If renewable sources of energy were used for the electrolysis, then the CO2 footprint would reduce by about 95%, and many of the other sources of CO2, for example in the mining and transportation of ore could be reduced by using alternate form of power. However, the energy requirement would remain and in fact with the increase in renewable infrastructure like wind power the requirement for steel will increase so the current 70 EJ/year will go up and Aluminium at 20 EJ/year will increase because of lightweighting in transport. A 2019 OECD forecast has suggested that the consumption of most raw materials will double by 2060 and with it the concomitant energy requirement. It is estimated that up to 150 Mt/year of green hydrogen is required to remove fossil fuels from the metallurgical industry and presently there is not enough renewable energy to create that supply of green hydrogen.