Steel & Hydrogen

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Main messages

1. H₂ is (would be) a very good reducing agent to make steel from iron ore (integrated production route)
2. the steel sector produces large amounts of H₂
3. H₂ is competing with the direct use of electricity (electrolysis of iron ore) for steelmaking
4. steel would be an enabler of the H₂ economy
Hydrogen to substitute for coke? (1)

- 570 Nm$^3$/t DRI
- world potential need: 610 GNm$^3$/yr or 52 Mt/yr
- EU potential need: 68 GNm$^3$/yr or 5.8 Mt/yr
- historically, a CIRCORED plant was built and ran in Trinidad (presently mothballed & owned by ArcelorMittal). Other processes studied at pilot scale (TRL6) and lab.
- re-evaluated as part of the ULCOS program. Good substitute for coke (reducing agent), but no visibility in terms of availability and cost of hydrogen: work put on the back burner! Fundamental work in the US (flash smelter, Utah)
- potential market for H$_2$: 50% for transport, 25% for the chemical sector and 25% for the steel sector, major uncertainty!
H₂, a by-product of steel production? (2)

- H₂ is a major component of coke oven gas (COG) (60%)
- worldwide, 12.8 Mt/yr of H₂ in 2011
- today, COG is burned in the internal energy network of the steel mill (including power plant)
- many potentially higher value uses of COG were studied (ethanol, methanol, DME). One H₂ production unit used to be operated in Belgium (CARCOKE, 1980-1996). No implementation left today, except some injection in BF
- development work carried out to sell hydrogen ex COG and produce some more by reforming CH₄ in COG, driven by the expected market for FCV - which did not materialized as quickly as expected (JAPAN: COURSE 50)
- this H₂ might be made available to non-steel users, depending on price and price of substitution gas
H₂ or direct use of electricity? (3)

the ULCOS program has thus chosen to develop electrolysis (ULCOWIN, ULCOLYSIS) as an "ULCOS solution", rather than H₂ direct-reduction.
Steel an enabler for the H$_2$ economy? (4)

- **pipelines** for H$_2$ in Europe and USA stretch for 3000 km
- much work still goes into steel development to reduce risk of hydrogen embrittlement further (steel and welds)
- **steel tanks** are also a solution for storing H$_2$ in FCV (type I $\leq$300 bars) and, today, for transporting H$_2$ on trucks (200-300 bars)
Bibliography
Bibliography (1)

Bibliography (3)

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