Electrically powered syngas and hydrogen production from hydrocarbons

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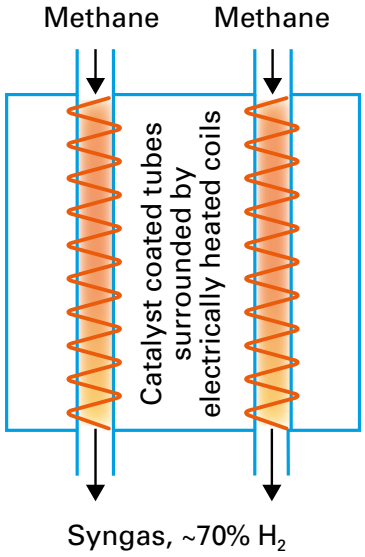
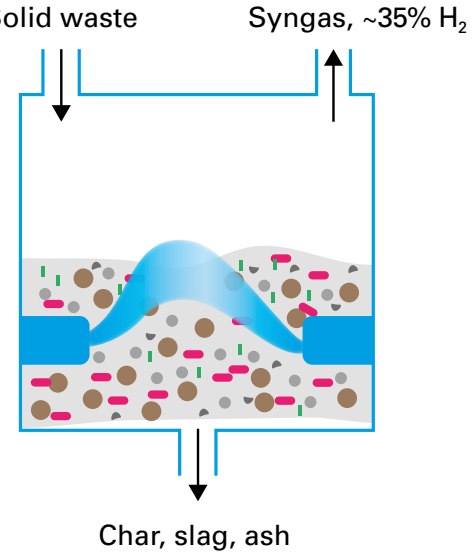
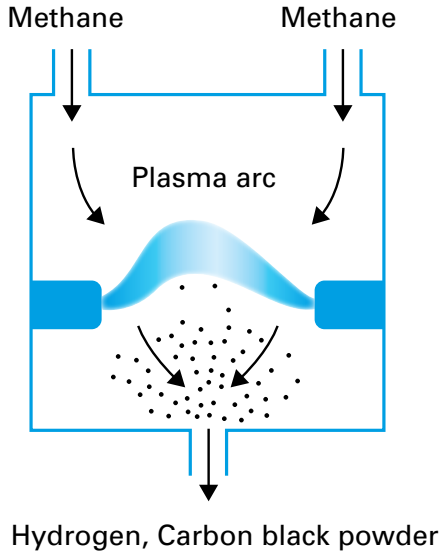
Notes:

- Combustion-heated SMR is an alternative to electrical heating
- Thermal or catalytic methane pyrolysis are alternatives to plasma
- Steam may be added to the waste gasifier to increase hydrogen yield, if waste is very dry
- For the plasma gasification reaction stoichiometry shown, methane is used as an example hydrocarbon
- Electrolysis is an alternative electrically powered pathway to produce hydrogen from water (AEC, PEM, SOE) or syn-gas from steam and carbon dioxide (SOE)







Process	Electrical Steam Methane Reforming (eSMR)	Plasma Gasification of Solid Hydrocarbons, eg waste	Plasma Pyrolysis of Methane (Methane Cracking, Methane Splitting)
Carbon feedstock	Natural gas, refinery gas or naphtha	Municipal solid waste, dried waste water treatment sludge, biomass, waste paper, tyres, etc	Methane from natural gas
Target chemical reactions	$CH_4 + H_2O \rightarrow CO + 3H_2$	Hydrocarbon + $O_2 \rightarrow 2CO + 4H_2$ Hydrocarbon + $H_2O \rightarrow CO + 3H_2$	$CH_4 \rightarrow C + 2H_2$
Additional side reactions	$CO + H_2O \rightarrow CO_2 + H_2$	Hydrocarbon + $2O_2 \rightarrow CO_2 + 2H_2O$	$2CH_4 \rightarrow C_2H_2 + 3H_2$
Carbon produced as	CO and CO_2	CO, CO_2, char, slag and ash	Carbon black powder
Product gas pressure	15 to 40 bar	Close to atmospheric pressure	Close to atmospheric pressure
Product gas temperature	~850 °C	~1000 °C	1500 to 2000 °C