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Editorial Article

Color Spectrum of Hydrogen Production and its Future

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EDITORIAL

The world's energy demand is increasing as per its growing population and standard of living.[1-2] The exploitation of fossil fuels to meet these rising energy demands are hence increasing global temperatures due to increased CO_2 and CH_4 concentrations in the atmosphere.[3-5] This proposes the urgent requirement to limit the usage of fossil fuels and utilize alternate promising fuels for energy generation.[6-8] Hydrogen (H_2) is a promising alternative clean fuel that can be a game changer in the future of the energy sector. The burning of H_2 only gives energy and water to the exhaust.[9-10] Due to its high energy content and clean combustion property, H_2ensures its place in future energy scenarios[11]. H_2 is a colorless gas that various available techniques can produce. The type of H_2 (i.e., grey, green, blue, turquoise, pink, brown, white, etc.) is represented as its color spectrum based on its production technique. The different types of H_2 production techniques via utilization of energy sources such as fossil fuels, hydro, electricity, solar or nuclear, along with their color spectrum, has been discussed in this article.

Green H_2 is referred to as H_2 produced by the electrolysis of water. The energy source utilized to split water into H_2 and O_2 is purely renewable, i.e., solar or wind-powered. This makes it the cleanest way to produce H_2 without leaving carbon footprints.[12]

Blue H_2 is a term for the H_2 produced via splitting natural gas into H_2 and CO_2 by employing the reforming processes such as Steam Reforming of Methane (SRM) or Auto Thermal Reforming of Methane (ATR). However, the CO_2produced with H_2 during the reforming process is captured and stored. Since CO_2 is the major greenhouse gas trapped in the process without leaving it to the environment, this eliminates the impacts of global warming.[13]

Grey H_2implies the H_2produced by using fossil fuels like natural gas via gas reforming techniques such as SRM or ATR. The process is very similar to that of the blue H_2 production technique but differs in dealing with CO_2 produced during the process. Currently, around 95% of the world's H_2 produced is grey in nature since the CO_2 produced is not captured and is released free into the atmosphere.[14]

Pink H_2 production is very similar to that of green H_2, i.e., by electrolysis of water. The process, however, differs in using the energy source for the process. The power used for pink H_2 synthesis is nuclear energy, unlike green H_2, which uses solar or wind energy.

Another type of H_2 production process focused rigorously in the present scenario is the Turquoise H_2. This process employs the pyrolysis of CH_4 to produce H_2 and solid carbon. It is expected that Turquoise H_2 can be a promising future technique for H_2 production by using heat produced by renewable energy sources. Furthermore, the produced carbon can be stored in the solid form in a limited space for utilization in several other operations.

The black or brown H_2 refers to the H_2 that employs black (bituminous) or brown (lignite) coal via gasification. This type of H_2 production process is totally opposite of that of green H_2 and is most damaging to the environment. In addition, CO_2 and CO are produced as a by-product during the process and released directly into the atmosphere. Finally, the white H_2 refers to the naturally occurring H_2 in the geological formations underground. These H_2 deposits are formed by fracking and cannot be used currently due to the deficiency of current exploitation techniques.

For a sustainable future, the usage and dependence on the fossil fuels needs to be reduced. The sustainable development in the only key to fulfill the pledges made during the Paris Agreement and to control the global temperatures is the most urgent amongst them. Therefore, several colors of the H_2 production spectrum will fade with time while many others will boom. This is due to their simultaneous carbon capture approach along with the clean H_2 production technique. This fact is supported by recent multibillion-dollar projects signed by different world governments and private ventures, including the USA, KSA, Australia, Germany, U.K, Japan and Russia for commercial blue, green, and turquoise H_2 projects. Hence, it may be concluded that the future of H_2 as an energy source lies in the blue, green, and turquoise spectrum since it is the need of the hour to protect the environment and sustainable development.

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