



Harnessing Hydrogen From Wastes



WASTES ARE A DOMESTIC RESOURCE...that can be used to produce energy in a sustainable, reliable and economical way.

W2E specializes in providing solutions to waste disposal issues by utilizing these wastes to generate hydrogen for use as a substitute for hydrocarbon fuels.

Renewables are fast gaining popularity, and the concept of transportation fuels, such as ethanol, from non-petroleum sources is becoming familiar to a majority of consumers.

Hydrogen has the potential to provide energy for stationary conversion devices using fuel cells, as well as for transportation needs such as use in on-road and off-road vehicles.



Global Energy

The global energy infrastructure has its foundations deep in fossil fuels. By the year 2050, the global requirement is expected to be a minimum of the equivalent of six billion gallons of oil per day. If all of this energy were to come from hydrocarbon fuel, the earth would face unprecedented challenges in environmental deterioration, as well as incredible economic issues caused by competition for this energy.

Hydrogen Utility

Many countries have begun hydrogen utility programs, specifying the use of hydrogen as the preferred fuel for the future, due to its inherent environmental benefits, such as the drastic reduction of greenhouse gases. This wide application of hydrogen targets the replacement of conventional fuels such as oil, fossil fuels, and natural gas for energy conversion, power production, vehicles, and for heat. **To provide a real replacement and be truly renewable, this hydrogen should be generated from sources other than natural gas or even water. Utilizing natural gas to make hydrogen is an inefficient use of that hydrocarbon source. Using water to make hydrogen also results in an inefficient process, using a great deal of electricity to produce the hydrogen.**

Practical Hydrogen Production

As countries continue to expand the mainstream use of hydrogen, the development of a practical method of dispensing hydrogen must also be developed. The typical infrastructure for the distribution of fossil fuel products is not necessary for hydrogen, since it does not require extensive processing similar to that of fossil fuels. In fact, hydrogen can be produced and dispensed at the same location.

The production of hydrogen from a domestically available renewable resource at an efficient and economical rate will provide the coming "Hydrogen Economy" with its own set of financial and environmental benefits. To accomplish this, the foundations to achieve this global objective must be, as they are in petroleum products, well established. In the case of viable hydrogen feedstock materials, these foundations are already in existence, and in many places, have been for hundreds of years. They are the infrastructure that comprises the solid waste management industry.

By using this simple and natural existing infrastructure that collects, sorts, and recycles waste in any country, the feedstock to produce hydrogen is readily quantifiable. This is the very material that is deposited in landfills, or is burned or incinerated to eliminate it from the ecosystem, leaving only the worst traces of it behind – in our air and water and earth. This feedstock will serve us far better if it is used for the production of hydrogen, in the very places that collect it near population centers. This conversion of waste into hydrogen and its subsequent use will eliminate or reduce the use of conventional fuels for transporting it to landfills. It will also allow the dispensing of hydrogen right at the collection center. The solutions approach of W2E provides the integration of technologies for a sustainable use of any biomass or any solid waste material to manufacture this renewable fuel at the clients' facility.

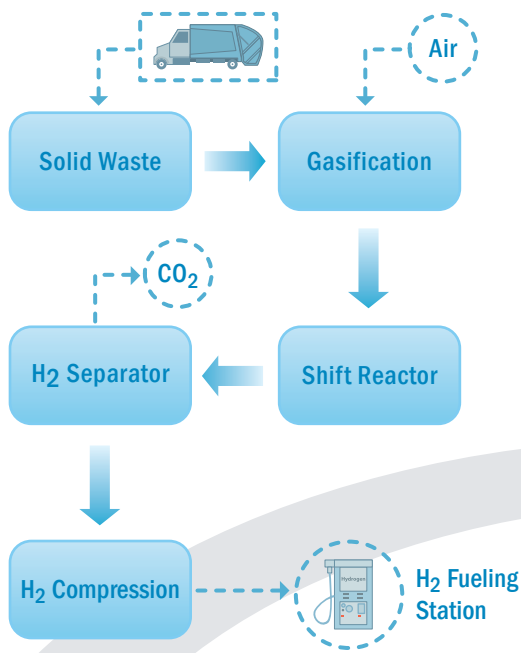
W2E SOLUTION THAT WORKS:

The W2E solution utilizes a simple approach, using the clients' current infrastructure to provide hydrogen for local consumption. The W2E solution consists of the following elements:

- W2E will utilize locally generated wastes to produce hydrogen, instead of expensive fuels,
- Hydrogen is produced for local consumption; therefore it is not dependent upon a distribution infrastructure or external market,
- Hydrogen is produced from wastes with the generation of synfuels as an intermediary step. In the event that the hydrogen demand is diminished, the synfuels can be used to replace any other fuels used locally to produce heat, power or steam,
- W2E will utilize versatile, small-scale, waste-to-hydrogen systems that will operate with various types of wastes, including municipal wastes, industrial wastes, food wastes, biomass, animal wastes, agricultural wastes, municipal sludge, and any other waste that has a carbon content,
- W2E's solution for waste-to-hydrogen will be equally effective for conventional fuels for producing hydrogen and therefore this solution would have a backup when wastes are not available.



HYDROGEN PRODUCTION FROM SOLID WASTE



W2E TECHNOLOGY

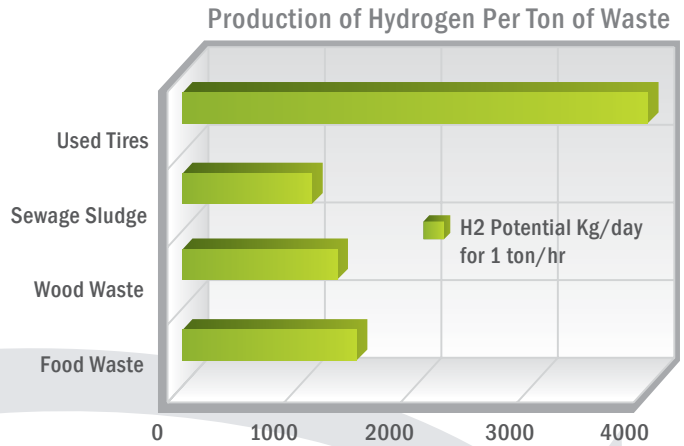
W2E utilizes a small-scale waste gasification system for converting wastes to hydrogen. This includes the conversion of organic-containing solid, liquid and gaseous wastes into uniform and clean burning synthesis gas as an intermediate step with its ultimate conversion to hydrogen as a final step. The process converts any solid, liquid, and gaseous organic wastes that have a fuel value; using air and water to create reactions, which in turn, produce uniform synthesis gas. This W2E solution is very flexible and can be applied to varied, locally generated wastes, such as forestry and agricultural residues, animal wastes, bacterial sludge, sewage sludge, municipal solid waste, food wastes, animal bovine parts, fungal material, industrial solid waste, waste tires, coal washing residue, petroleum coke, oil shale, even coal, peat and lignite, waste oil, industrial liquid wastes, residuals from petroleum refining and volatile organic compounds generated by the industrial processes. The W2E solution converts these wastes into gaseous fuels with the maximum conversion efficiency available in a gasification technology.

During the gasification of wastes, the majority of solid wastes break down into simple gases. The transformation of solid wastes into gaseous fuel is carried out in substoichiometric conditions. In this process, the air supply to the reactor is kept below that required for complete combustion, generating fuel gas from the solid wastes, which consists primarily of a mixture of hydrogen, carbon monoxide, carbon dioxide, methane and water vapor, while the solid residue is comprised primarily of ash. After cleaning, this fuel gas can be used directly for producing electricity, steam, or combined heat and power.

For hydrogen production, this mixture of gases is further reacted with more steam to convert carbon monoxide into hydrogen and carbon dioxide. The hydrogen is then separated from the gas mixture by using a pressure swing adsorption (PSA) process to yield 99.999% pure hydrogen.

HYDROGEN PRODUCTION POTENTIAL FROM WASTES

Figure below illustrates the potential for the production of hydrogen from wastes typically found at most locations.



As a practical note, each person in the United States on an average generates about 4.5 pounds of waste per day, or over 1600 pounds per year, most of which is deposited in municipal solid waste (MSW) landfills. For a town with a population of 10,000 inhabitants, the average daily production of wastes is in the range of 45,000 pounds per day, or approximately 1 ton per hour. This is a significant quantity. When this is added to the other wastes that are generated by nearby industries, including waste oils, waste tires, packaging materials, used gloves, and others, we are looking at least 2 tons per hour of an excellent resource for hydrogen.

The wastes can be treated individually or as mixtures. Based on above numbers one can safely assume that 1 t/h or 24 t/d of mixed waste will easily generate over 2000 kg/d of hydrogen which is enough to service a fleet of 400 vehicles.



POTENTIAL BENEFITS OF W2E SOLUTION

- Fast track development of "Hydrogen Economy";
- Energy security through the development of distributed alternative energy from domestic resources;
- Effective deployment of waste to energy technologies yields clean methods of providing waste to energy;
- Elimination of wastes from landfills;
- Reduction in greenhouse gases through the use of hydrogen;
- Customer specific energy solutions are integrated into and work within the parameters of existing infrastructure.



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