A Russian View On a Hydrogen Future

At least they've done the calculations and aren't mythical idealists like Greenpeace types

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In this pragmatic view of a hydrogen future, the authors state that to replace all engine fuels in the world (2,200 million tons, out of which 60 million tons are consumed in Russia), 679 million tons of hydrogen will need to be produced.

Hydrogen power engineering — is energy of the future", efforts are being undertaken in the US, Europe and Russia to implement the above postulate. We have tried to calculate the quantity of hydrogen needed to transfer to it all transport of big cities, i.e. the quantity that will be required to replace engine fuels. All calculations were based on maximum coefficients of efficiency and the most optimistic figures. The conclusions made from the obtained figures seem interesting not only for scientists but also for general public: thoughtless implementation of hydrogen programs might require much more significant quantities of mineral weath than it does at present and result in disastrous deterioration of environment.

In hydrogen power engineering, hydrogen is the main vehicle for power transfer. Hydrogen is just the power carrier, but not its source. Energy is required in the course of getting hydrogen, the methods for getting hydrogen are not that numerous: chemical conversion of organic matter (combustible minerals, biomass); water electrolysis; thermal water disintegration, including that by nuclear energy.

To replace all engine fuels in the world (2,200 million tons, out of which 60 million tons are consumed in Russia), 679 million tons of hydrogen should be produced, that is the required amount is almost four times less as hydrogen is a more power-consuming fuel. If hydrogen is obtained through water electrolysis to which all adherents of hydrogen power engineering are standing up for, than 29,700 billion kilowatt-hours of electricity will be required for this purpose. However, all electric power stations of the world taken together produce only 15,500 billion kilowatt-hours! Therefore, to transfer motor transport to hydrogen, it will be needed to increase global power generation by 3 times (current ordinary consumers are still in place)!

By the way, more than a half of all global electric power, or more precisely 63-64 percent of it, is now generated at thermoelectric power stations where combustible minerals are burnt. This figure is unlikely to change significantly in next years unless nuclear fusion or something similar starts working. This is a very important fact as any increase in plant output that will be needed for hydrogen generation through electrolysis will result in expansion of burning fossil minerals combustion.

Hence, the fundamental conclusion is - transfer to hydrogen fuel in the next decades would require quite a different way — hydrogen re-orientation of oil-refining and gas-processing industry. That is, instead of engine fuels production, combustible fossil minerals will have to be reprocessed for hydrogen. Then, discharges from big cities will be indeed removed and transferred into hydrogen generation locations.

The next key question is — what method to apply to get hydrogen and what it should be received from? Apparently, from natural gas as it has the highest hydrogen content as compared to mineral oil and coal. Generation of one ton of hydrogen would require 2.8

to 3.1 tons of natural gas or 3.4 to 3.6 tons of mineral oil. There exist several processes for getting hydrogen from natural gas, and temptation is to choose a simple, lately smooth-running solution (the so-called steam or steam-oxygen convert conversion), which would be a mistake. These processes are well studied, hundreds of companies are able to design them perfectly, they are not very expensive. Under these methods, gas is required not only directly for technology, but also for concomitant processes. There exists a new, not quite familiar technology — membrane partial oxidation. If all capital and operational expenses are calculated accurately, it would turn out that the little-developed partial oxidation process requires almost 10 percent less methane. That is the difference of 3.1 and 2.8 tons per1 ton of hydrogen — these are well and poorly organized hydrogen obtaining methods. The price under consideration is very high.

Another important aspect is the CO2 discharges and execution of the Kyoto protocol. As of today, about 7 million tons of CO2 are excreted on the Earth as a result of engine fuels combustion. Emission is concentrated in cities, and if gasoline is replaced by hydrogen, the discharges in the cities will be decreased. However, they would not disappear completely, they would simply be moved out to hydrogen production locations, which is all the same to global balance of carbonic acid gas.

Electrolysis will provide deterioration of carbonic acid gas discharges by twice as compared to the present-day situation. Only if methane is applied, some decrease in the CO2 discharges is possible (the optimal result — 5,340 million tons of CO2 in case of hydrogen generation via a little-developed method of partial oxidation). But if hydrogen is received from mineral oil (to say nothing about coal), ecological winning will be significantly less.

As a result, we have to acknowledge that regardless of the fact that hydrogen is very good as the energy carrier, calculations should be made thoroughly before a certain technology is implemented or a research direction is developed.

It should be noted that getting hydrogen via biomass conversion or with the help of solar energy have the right to exist but only as a local solution to the problem. It is impossible to sow billions of hectares with rape and to cover the entire territory of the Earth with photoelectric cells. By the way, in the latter case we shall hardly achieve the present-day capacity of all electric power stations of the Earth.