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## POSSIBILITIES FOR THE PRODUCTION AND USE OF HYDROGEN AS A FUEL IN EXISTING BOILERS

**Abstract:** *The process scheme is developed for climate neutral production and use of hydrogen as a fuel in existing boilers at heat supply enterprises.*

**Keywords:** *hydrogen, municipal solid waste, incineration*

**Abbreviations:** *MSW – municipal solid waste, RDF – refuse derived fuel*

Using of hydrogen at present is a key priority to achieve the European Green Deal and Europe's clean energy transition [1], and application of it as a fuel for at least partial replacement of the fossil fuels is one of the essential components to support the EU's commitment to reach carbon neutrality by 2050 and for the global effort to implement the Paris Agreement while working towards zero pollution [2].

In spite of the obvious environmental advantages, such using creates a number of currently unresolved problems due to the peculiarities of the hydrogen characteristics as a fuel, which stipulates the necessity for changing of the modes of its combustion, of the construction of fire chambers, heat-receptive elements, etc. The problems for hydrogen practical use in combustion processes in the existing boiler equipment are pointed out in [3], and maybe the main problem is that the adiabatic hydrogen combustion temperature in air is high, about 260° higher than the adiabatic combustion temperature of usually used natural gas.

However, this peculiarity may be quite useful for processes where the combustion temperature is usually insufficiently high, and must be increased.

Such a process is, in particular, the thermal processing of the municipal solid waste (MSW).

The world's leading countries consider solid waste as an alternative local energy resource that is constantly generated and is very convenient logistically – in populated areas, close to energy consumers.

At present in Ukraine, especially under conditions of military aggression against our country, one of the largest threats to national security is Ukraine's energy dependence on imported natural gas; reducing of this dependence is a priority task for ensuring the stable operation of Ukraine's energy system. The special State targeted economic program for the energy recovery of MSW at enterprises – heat energy producers is now under development in Ukraine, the purpose of which is to attract the energy potential of MSW due to its energy recovery to the country's energy balance, as well as to solve the problem of sanitary cleaning of cities due to the utilization of a significant share of MSW.

According to the EU legislation [4], which is now under implementation to the Ukrainian legislation, waste incineration plants shall be designed, equipped, built and operated in such a way that the

temperature of combustion even under the most unfavourable conditions must be kept at least at 850°C for at least two seconds.

With taking into account the quite low calorific value of usual MSW (about 1650 kcal/kg) and even of the Refuse derived fuel (RDF) made from MSW (2000-4000 kcal/kg), keeping of such temperature often requires an additional high calorific fuel.

The possible solution is using the hydrogen as such additional fuel. The proposed process for realizing this technique is schematically presented at Figure 1.

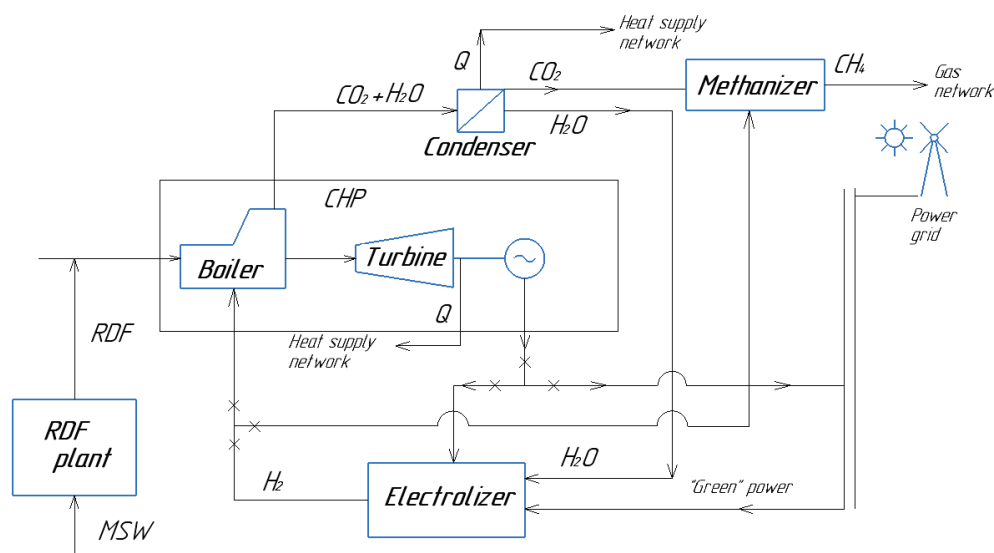


FIGURE 1. Process scheme for using hydrogen at waste incineration

Hydrogen is generated by electrolysis with using “green” power from renewable sources (solar, wind, etc.) or own produced at the CHP, and is fed partly to the fire chamber of boiler combusting RDF, causing increasing of the combustion temperature, and partly is fed to the methanizer.

The water vapour contained in flue gases is condensed to liquid water, and carbon dioxide is fed to the methanizer.

During the reaction of interaction of hydrogen with carbon dioxide from flue gases of boilers, synthetic methane is formed in the methanizer, the formed methane-hydrogen mixture (up to 10% hydrogen) may be used practically as the usual methane, in particular may be used in existing natural gas firing boilers, or fed to a local natural gas network.

The carbon dioxide formed during the subsequent burning of such a mixture is no longer counted as a greenhouse gas emission.

The above process idea is at the stage of obtaining a patent.

Such process is proposed by the authors for implementation in the heat supply schemes for cities of Kyiv (at the heat supply station ST-1) and Odesa (at the region boiler-house Pivdenna-1), developed with participation of the authors.

## References

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