Use of Hydrogen for Economy of Fuel in Steam Turbine Plants

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Two methods of use of hydrogen for increasing steam turbine plants efficiency were proposed. The first method [1] is based on mixing of steam, exiting from the boiler's super-heater, with products of combustion of methane or hydrogen in oxygen. Such solution will increase the maximum temperature of the working substance. It should not cause problems for turbines. For the plant-prototype, increasing of maximum temperature of the cycle from 540 °C to 800 °C will increase thermal efficiency by 8.1 % and effective efficiency by 6.4 % (up to 50.4 %).

In the second method [2] it is proposed to raise the maximum temperature of the working substance and to continue the heat supply on a major part of the expansion process in the turbine. This can be done by mixing steam, exiting from the boiler's super-heater, with products of combustion of hydrogen in oxygen and excess hydrogen. During expansion in the turbine oxygen is gradually admixed to the working substance, and a reaction between excess hydrogen and oxygen will produce heat. Thus major part of heat will be supplied at the cycle's maximum temperature. For the plant-prototype, increasing the maximum temperature from 540 °C to 800 °C and the isothermal expansion of the working substance will increase thermal efficiency by 20.3 % and effective efficiency by 8.8 % (up to 56.3 %).

Hydrogen may be obtained by thermochemical conversion of natural gas, and oxygen in an air separation plant. Use of hydrogen instead of natural gas allows pure steam after combustion to be obtained. The repayment term of the modified plant due to fuel economy will be 2.5 years for first method and 5 years for the second.

[1] A.A.Vasserman and M.A. Shutenko, Patent of Ukraine on invention #57773 "Method of increasing of steam's temperature before the turbine," Bulletin "Industrial property", 2003, #7.
[2] A.A.Vasserman and M.A. Shutenko, "Method of implementation of steam turbine plant's cycle." Application of ONMU # 20040403178 for patent on invention.