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¹Adrian, BIRTAS, ¹Iulian, VOICU, ¹Gheorghe NICULAE, ^{1,2}Radu, CHIRIAC, ²Pierre, PODEVIN, ²Georges DESCOMBES

¹University "Politehnica" of Bucharest,
Faculty of Mechanical Engineering,
Spl. Independentei 313, sect.6, 060042
Email : adrianbirtas@yahoo.com

²Conservatoire national des arts et métiers
Laboratoire de génie des procédés pour l'environnement l'énergie et la santé
LGP2ES – EA21 - case 2D3R20
292, rue Saint-Martin 75003 Paris Cedex 03
Email : pierre.podevin@cnam.fr

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ABSTRACT - The continuous accumulation of the greenhouse gases emissions in atmosphere, mainly the CO₂ emission, combined with the expected rapid depletion of oil resources have oriented the engines research and development activities performed in the last decades towards the alternative fuels usage. Among the new fuels investigated, hydrogen occurred as a promising fuel due to its combustion characteristics and to no-carbon based emissions releasing, only if the inherent problems related to its production, storage and distribution will be favorably solved. Thus, the on-site hydrogen safe and adequate production seems to represent an interesting solution by eliminating the distribution inconvenient when the demanded energy for hydrogen production is associated with feedstock and technologies which are not based on carbon fuels. In this sense, the recovery of the wasted energy which is typically lost as rejected heat in a normal engine operation condition, associated with hydrogen production by water electrolysis and its use as a supplemental fuel has been theoretically investigated by means of the AVL Boost simulation code. The results obtained show that the combined power production with hydrogen generation for partially fuelling could improve engine's overall efficiency and reduce the global emissions.