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ABSTRACTS

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chamber and performing gas chromatographic analysis, we can monitor the achieved extent of chemical conversion, and the nature and amounts of produced substances (species yields).

A series of such experiments is performed to study how the experimental conditions affect the conversion of methane and the yields of products. Results show that conversion at engine-typical compression ratios and initial conditions (temperature, pressure) is possible, if the natural gas is diluted with low heat capacity gas (e.g. noble gas Argon). At post-compression temperatures of about 1500 K, significant conversion sets in. The spectrum of produced substances depended on the temperature range: Higher compression temperatures tend to yield more C_2H_2 and H_2, lower temperatures lead mainly to C_2H_4 and C_6H_6.

With respect to the conversion into chemical energy, the experimental data show that the difference of standard energy of formation between products and initial substance (NG surrogate methane) can be in the range of 10 MJ per kg of methane. This high value encourages the use of the conversion also for high energy density energy storage.

ON SOME EFFECTS OF DIFFERENT TEMPERATURES ON THE LIFETIME OF THICK-WALLED VESSELS UNDER MECHANOCHEMICAL CORROSION CONDITIONS

Sedova O.S., Pronina Y.G.
Saint Petersburg State University, Russia
y.pronina@spbu.ru

Corrosion is natural deterioration of materials due to their interaction with environment. The rate of corrosion may be enhanced by increasing temperature, however, sometimes the latter may decrease the corrosion rate due to faster formation of protective layers. One of the other ways how temperature may affect the corrosion rate is mechanical activation of corrosion by thermal stresses caused by non-uniform heating. This paper is devoted to the study of the mentioned effects of different temperatures of the internal and external environments on the lifetime of the vessels under the conditions of mechanochemical corrosion. The rates of corrosion on the inside and outside are assumed to be linearly dependent on the circumferential stress on the related surface, as well as on their temperatures, with possible inhibition of corrosion taken into account. Benchmark analytical solutions are presented. In the presence of internal or external pressures, the elastic – not the thermal – stress component plays a decisive role in the synergistic growth of mechanical stress and the corrosion rate. In this case, one of the stress fracture criteria should be used for the assessment of the lifetime of the vessel. In the cases when the pressures of the internal and external media are absent or equal one to another (for equal or unequal temperatures), the solutions should be adapted to the criterion of a minimal residual thickness. The lifetime of the vessels is determined by the competition of different mechanisms discussed in the paper.

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ACCOUNTING FOR THE SKIN EFFECT IN HYDROGEN-CHARGED SAMPLES IN THE HEDE MODEL OF CRACKING

Sedova Yu.S., Polyanskiy V.A., Bessonov N.M.
Institute for Problems in Mechanical Engineering Russian Academy of Sciences (IPME RAS) Saint Petersburg, Russia
julka0309@mail.ru

As known, hydrogen embrittlement and hydrogen-induced destruction are one of the serious problems of modern engineering practice. Nowadays, several approaches have been proposed to describe this phenomenon. One of the most widespread and most developed is the hydrogen enhanced decohesion model (HEDE). Its mechanism presupposes fundamentally brittle fracture as a result of hydrogen embrittlement without plastic deformation.

In all currently existing studies of the HEDE model, the hydrogen content throughout the sample is considered uniform. At the same time, it was experimentally established that the procedure for charging specimen with hydrogen leads to a highly uneven distribution of the concentration of this substance over its volume. In a surface layer with a thickness of the order of one material grain size, its value can be tens of times greater than the value inside the sample. This phenomenon is called skin effect, and so far, modeling of hydrogen destruction has been carried out without taking this fact into account.

In this work, we focused on the application of the HEDE model of brittle fracture taking into account the skin effect from charging the samples with hydrogen. We performed finite element simulation of the fracture of a hydrogen-charged steel cylindrical corset specimen with a notch, setting the specimen parameters and loading conditions to be typical for hydrogen brittleness experiments. According to the results, it was found that the unevenness of the distribution of hydrogen concentration can be the main source of the dual nature of sample fracture - brittle induced by hydrogen on the surface of the sample and common inside its volume.

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