

10. Recommendations

Based upon the results obtained and observations made throughout the experimental program, a set of guidelines have been developed that should form the basis of a continuing effort to further refine understanding of the formation of carbon during methanation.

First, the experimental program should be modified to include as many different methanation catalysts as possible, while at the same time, reduce the number of experiments with each catalyst/feed gas pair to a select group of operating conditions. Experience shows that catalysts

which have a propensity to form carbon, will do so under virtually all operating conditions. Furthermore, these experiments should at least include some on-stream time variation in order to quantify the rates of carbon formation. This would greatly increase understanding of the role that the fine structure, as detailed by pore volume, pore volume distribution, carrier composition, nickel crystallite size and dispersion, etc., play in carbon formation. Efforts should also concentrate on catalyst treatments which have been shown to modify catalyst reaction behavior, such as steam treatment.

In conjunction with these experiments it is necessary to expand the types of analytical analyses practiced so as to more accurately assess the morphological changes the catalyst undergoes. For example, electron microscopy work should be incorporated in order to gain insight into the fine structural changes and to determine the nature of the formed carbon, graphite or amorphous.

Finally, these initial results also warrant further work on the area of carbon removal by in-situ controlled oxidation and its cumulative effect on structural properties as well as reactivity related characteristics.