Energy Utilization Research

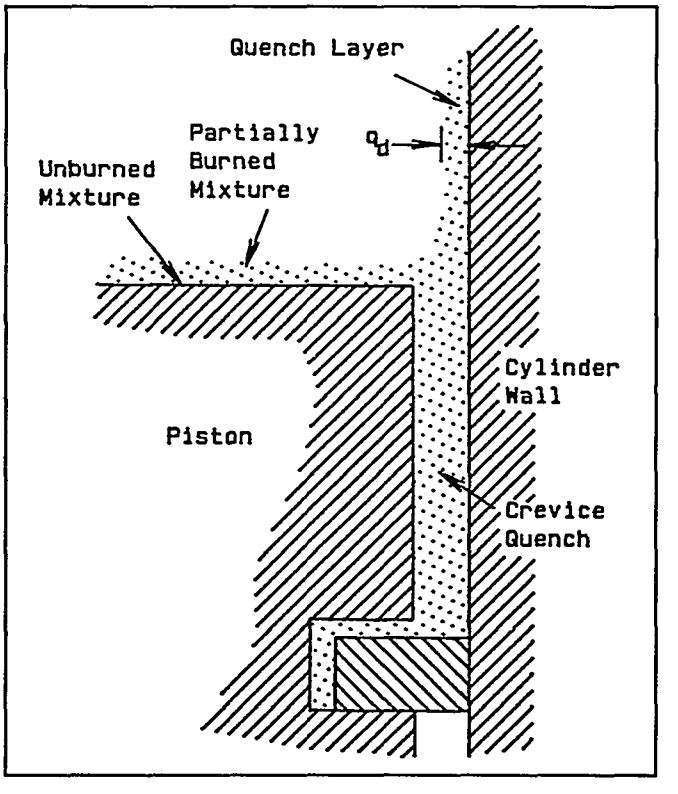
ENERGY CONVERSION AND UTILIZATION TECHNOLOGIES

Mathematical Model for Designing Automobile Engines

Advanced engine concepts have a tremendous potential to save energy; the transportation sector alone consumes about 20 quads of liquid fuels every year. The successful development of more efficient engine concepts largely depends upon the fuel spray activity in the combustion chamber of the engine and the ability of the engine to consume the fuel-air charge completely. Hence, the capability to represent an evaporating fuel spray in numerical calculations of chemically reactive fluid flows is of steadily increasing interest to internal combustion engine designers and manufacturers. DOE has developed, documented, and released into the public domain a three-dimensional engine combustion computer model, KIVA. Although developed with applications to internal combustion engines specifically in mind, because of the generality of the concepts on which it is based, KIVA can be adapted to a variety of other applications with only minor modifications. This new capability to model fuel sprays has lead engine designers and developers to address comprehensively the engine combustion problem and incorporate design changes according to the new insight gained. KIVA has now been accepted as the industry standard for automotive engine model development. Efforts continue to improve the capability of KIVA to more accurately characterize turbulence typical of chemically reactive flows. It is currently being extensively used by automotive industry researchers in developing energy-efficient, EPA-compliant engines.

Sources of Unburned Hydrocarbon Emissions from Automotive Engines

Lack of knowledge of basic thermochemical processes involved in the combustion of fuels has resulted in escalating equipment costs for pollution control and in the failure of designers and developers to exploit potential efficiency improvements in combustion systems and devices. For more than 20 years the quench layer theory dominated the technical literature as the model for unburned hydrocarbon emissions from automotive engines. A new understanding about the sources of unburned hydrocarbon emissions from dilute homogeneous-charge (DHC) engines has developed from the collective efforts of eight industry and DOE contractor research teams working primarily within the DHC cooperative group of the ECUT Engine Combustion Technology Project. The researchers have completed the experiments and analyses to prove conclusively that conventional wisdom was incomplete regarding the



ECUT engine combustion research identified "crevice quench" as a major source of unburned hydrocarbon emissions from DHC engines.