An Integral Model for Calculation of LPG Jet Development in Combustion Chamber of Spark Ignition Engine

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Abstract: Under pressure of environmental laws, which are stricter and stricter, the automotive manufacturers ought to intensify their research development so that their products could meet the requirements of environmental exigencies. The improvement of internal combustion engines by applying electronic control technology has given spectacular results on emission reduction. Besides, the application of alternative fuel in internal combustion engine is also a good contribution to environmental protection.

In the last decade of 20th century, a new kind of spark ignition engines has been developed: the Gasoline Direct Injection (GDI) engine. This kind of engine, particularly the stratified mixture one, is highly attractive thanks to its performance in economic and pollution emission aspects. The mixture fraction is very lean in partial load. Thus, in view of ignition in this case, a good equivalent ratio around the spark plug is needed. This requires an optimal organization of mixture distribution in function of time and space in the combustion chamber of the engine.

Gas direct injection engine will be an ideal one for the purpose. In fact, the engines which operate on natural gas or liquefied petroleum gas (LPG), can satisfy easily the strictest standard of pollution emission actually. So if we can apply gaseous fuel on direct injection spark ignition engine, the advantages will be doubled. Our research is a contribution to develop a gaseous direct injection engine in which LPG in liquid state is used.

The present paper introduces some calculation results on distribution of fuel and oxygen concentrations of LPG jet in the combustion chamber of spark ignition engine. The conserved scalar model is developed for species exchange in turbulent diffusion jet. The integral equations system for convection-diffusion process is closed by turbulence k-e model. The model is validated by experimental data of air jet given by LDA method. It is then developed to predict the velocity and concentration fields of LPG jet in combustion chamber in order to develop a new kind of engine: Gas Direct Injection Engine which has double advantages of GDI engine and gaseous fuel

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