COMPARATIVE STUDY OF PRESSURE WAVE MATHEMATICAL MODELS FOR HP FUEL PIPELINE OF CEUP AT VARIOUS OPERATING CONDITIONS

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Abstract- High pressure (HP) Fuel Pipeline is one of the major components of Combination Electronic Unit Pump (CEUP) fuel injection system which has important role in building up of fuel pressure necessary for fuel injection. Three different 1D mathematical models of damped wave equation (WE) namely linear damped, viscous damped and damped model have been developed in MATLAB to investigate fuel pressure inside HP fuel pipeline of CEUP fuel injection system at various operating conditions of diesel engine. Lab experiments have been conducted to measure the pump side and injector side pressures by using KISTLER 4067 piezoresistive pressure sensors under controlled environment. Each model has been verified by comparing its simulated results with those of experimentally verified AMESim numerical model of CEUP system. Model evaluation statistical techniques like "Root Mean Square Error" (RMSE) and "Index of Agreement" (IA) have been used to quantify the predicted results of each mathematical model at various operating

conditions. From analytical and quantitative analysis it has been concluded that viscous damped mathematical model predicts more accurately as compared to rest of models specially at all combinations of cam rotational speeds and cam angles of 700rpm, 1100rpm and 6°CaA, 10°CaA and 14°CaA respectively. Damped mathematical model predictions have been found relatively more precise at cam angles of 6°CaA and cam rotational speeds of 900rpm and 1300rpm. Moreover linear model was accurate at cam rotational speed of 900rpm and cam angle of 14°CaA.

Index terms*:* Wave equation, Mathematical model, High pressure fuel pipeline, Finite difference, RMSE, IA.