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THE EFFECT OF COMBUSTION CHAMBER GEOMETRY LAYOUT ON COMBUSTION AND EMISSION

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ABSTRACT

In this paper some results concerning the combined effect of the tumble flow and combustion chamber geometry layout variations on flame front shape and its propagation through homogenous mixture of isooctane and air are presented. Spatial distributions of NO in different combustion chamber geometries are presented as well. The basic combustion chamber geometry layout considered consists of the flat head with two vertical valves and a cylindrical bowl subjected to variations of depth and squish area. All results presented were obtained by dint of multidimensional modeling of reactive flows in arbitrary geometry with moving objects and boundaries with modified KIVA3 and KIVA3V source codes. Two additional computer codes were applied to generate boundary conditions for KIVA3V calculations with moving valves. The AVL TYCON code was used for the calculation of valve lift profiles, and AVL BOOST code was used for the calculation of relevant data set in the valve regions. Different combustion chamber geometry layouts generate different levels of squish, and the combustion effects in essence depend on the interaction of that flow with tumble. It was found that for particular combustion chamber shapes with different diameter/depth aspect ratios entirely different flame front shapes and propagation velocities were encountered primarily due to variations of fluid flow patterns in the vicinity of top dead center.

KEYWORDS

combustion, 3-D fluid flow, flame propagation

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REFERENCES [view full list]

1. Jovanović, Z., The Role of Tensor Calculus in Numerical Modeling of Combustion in I. C.

Engines, in: Computer Simulation for Fluid Flow, Heat and Mass Transfer, and Combustion in Reciprocating Engines (Ed. N. Markator), Hemisphere Publishers, New York, USA, 1989, pp. 457-541
2. Petrović, S., et. al., Modeling of Combustion in Otto-Cycle Engines (in Serbian), Faculty of Mechanical Engineering, University of Belgrade, Belgrade, 1995
3. Jovanović, Z., Petrović, S., The Mutual Interaction between Squish and Swirl in S. I. Combustion Chamber, Mobility and Vehicle Mechanics, 23 (1997), 3, pp. 72-86
4. Chen, A., Lee, K. C., Yianneskis, M., Velocity Characteristics of Steady Flow through a Straight Generic Inlet Port, International Journal for Numerical Methods in Fluids, 21 (1995), 7, pp. 571-590
5. Amsden, A. A., KIVA3V: A Block-Structured KIVA Program for Engines with Vertical or Canted Valves, Report LA-13313-MS, Los Alamos, N. Mex., USA, 1997
6. AVL TYCON, Users Manual, version 4.3, 1998
7. AVL BOOST, Users Manual, version 3.3, 2000
8. Mahmood, Z., Chen, A., Yianneskis, M., On the Structure of Steady Flow through Dual Intake Engine Flow (internal report), Kings College, London, UK, 1999
9. Jovanović, Z., Petrović, S., 3D Fluid Flow in I. C. Engine Combustion Chamber of Arbitrary Geometry, Proceedings, MOTOAUTO 97, Russe, Bulgaria, 1997, Vol. II, pp. 31-37
10. Jovanović, Z., The Modification of the Combustion Chamber Geometry Layout on the Basis of Fluid Flow Pattern Criteria, Proceedings, MOTOAUTO 99, Plovdiv, Bulgaria, 1999, pp. 31-37
11. Jovanović, Z., Petrović, S., The Effect of Squish Area Variation on Flame Front Shape and its Displacement, Proceedings, International Symposium Motor Vehicles - IC Engines, Kragujevac, Serbia, 1998, pp. 119-122
12. Jovanović, Z., Petrović, S., Tomić, M., The New Fluid Flow Criterion for the Characterization of Flame Front Shape and its Displacement, Proceedings, VII International Scientific Conference Simulation Research in Automotive Engineering, Lublin, Poland, 1999, pp. 1-7
13. Jovanović, Z., Petrović, S., The Effect of Tumble in Flame Front Shape and its Displacement in SI Engines, Proceedings, MOTOAUTO'03, Internal Combustion Engines, 2003, Sofia, Vol. I, pp.7-10
14. Jovanović, Z., The Displacement of the Reverse Tumble Center of Rotation during Induction and Compression, International Journal for Vehicle Mechanics, Engines and Transportation Systems, Mobility and Vehicle Mechanics, 26 (2000), 1-2, pp. 29-44
15. Jovanović, Z., The Mutual Interaction between Squish and Tumble in Combustion Chamber with Cylindrical Bowl, Journal for Vehicle Mechanics, Engines and Transportation Systems, Mobility and Vehicle Mechanics, 27 (2001), 1-2, pp. 19-32
16. Jovanović, Z., Petrović, S., Basara, B., The Effect of Port De-Activation on Fluid Flow in Multi-Valve Engines, Proceedings, MOTOAUTO 2001, Varna, Bulgaria, pp. 47-52
17. Jovanović, Z., Zeljković, I., The Modelling of Fluid Flow, Combustion and Emission in SI Engines - Multidimensional Approach (in Serbian), in: Equipment and Technologies for Emission Control from Stationary and Mobile Sources (Ed. M. Radovanović), Faculty of Mechanical Engineering, University of Belgrade, Belgrade, 1997, pp. 280-316
18. Jovanović, Z., Petrović, S., Some Implications Concerning Macro Flows and Combustion in SI Engines, Mobility and Vehicle Mechanics, 2005, pp. 97-118
19. CGS - Common Graphics System, LA Contract W-7405-ENG-36, Los Alamos, N. Mex., USA
20. GMV - General Mesh Viewer, LA-UR-2986, Berkeley, Cal., USA

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