

THE ANALYSIS OF SPARK IGNITION ENGINE INDICATOR DIAGRAM USING TWO ZONE MODEL OF COMBUSTION

In Classical thermodynamic methods of internal combustion engines indicator diagram analysis it is assumed the uniformity of pressure, temperature and gas composition throughout the combustion chamber. As far as spark ignition engine is concerned, these assumptions are very rough approximations since there are extremely big differences in temperature and composition between combustion products (behind flame front) and unburnt mixture in the area where flame front has not yet reached.

In order to consider the process more realistic, the presented method of pressure record analysis involves two zone quasidimensional model of combustion. Combustion chamber is divided into two zones containing products of combustion and unburnt mixture which are separated by the thin spherical flame front propagating throughout the chamber. Beside to thermodynamic equations based on the energy conservation law, this approach requires real parameters of chamber geometry.

Therefore, flame front area, combustion products volume and wall area wetted by burnt gases as the functions of flame radius and piston position have to be evaluated for particular shape of combustion chamber.

Theoretical model has been experimentally verified using collected pressure data from four cylinder, four stroke, water cooled 11 spark ignition DMB engine with wedge type combustion chamber.

Pressure diagram analysis gives the rate of combustion and temperatures of unburnt mixture and combustion products. In addition, the flame front location and velocity during combustion, as a function of crank angle, have been evaluated and compared with experimental results of flame propagation obtained using ionization technique. It has been concluded that there is very good agreement between measured flame propagation data and the data computed from pressure record.

Key words: SI engine, indicator diagram, combustion, two zone, model.

ANALIZA INDIKATORSKOG DIJAGRAMA OTO - MOTORA NA BAZI DVOZONSKOG MODELA SAGOREVANJA

Kod klasičnih termodinamičkih metoda analize indikatorskog dijagrama motora sa unutrašnjim sagorevanjem pretpostavlja se uniformnost polja pritiska, temperatura i sastava gasa u okviru radnog prostora. Kod oto-motora ovakve pretpostavke predstavljaju veoma grubu aproksimaciju, s obzirom na ogromne razlike u temperaturi i sastavu gasa u oblasti nesagorele smeše (ispred fronta plamena) i u oblasti produkata sagorevanja (iza fronta plamena).

U cilju realističnijeg sagledavanja procesa, kod prezentirane metode analize toka pritiska uvodi se kvazidimenzionalni dvozonski model sagorevanja kod oto-motora. Prostor sagorevanja je podeljen na zonu nesagorele smeše i zonu produkata sagorevanja koje su razdvojene frontom plamena u vidu tanke opne sferičnog oblika, koja se kreće kroz komoru. Pored termodinamičkih jednačina baziranih na I zakonu termodinamike, ovakav pristup zahteva i realne geometrijske parametre komore sagorevanja. Zbog toga se za konkretan oblik komore moraju odrediti površina fronta plamena, zapremina zone produkata sagorevanja i površina zidova okvašena produktima sagorevanja u funkciji radijusa fronta plamena i položaja klipa.

Teorijski model je eksperimentalno verifikovan koristeći podatke dobijene indiciranjem četvorocilindričnog, četvorotaktnog, vodom hlađenog oto-motora, radne zapremine 11 i komorom sagorevanja klinastog tipa, proizvodnje DMB.

Analiza snimljenog toka pritiska daje, pored zakona sagorevanja i temperatura nesagorele smeše i produkata sagorevanja i poziciju fronta plamena u zavisnosti od ugla klenastog vratila. Ovi rezultati su upoređeni sa eksperimentalnim rezultatima prostiranja plamena dobijenim primenom jonizacione tehnike, pri čemu je konstatovano veoma dobro slaganje.

Ključne reči: motor SUS, indikatorski dijagram, sagorevanje, dvozonski model.