
Heat and
Mass Transfer
C. Baumgarten
Mixture Formation
in Internal
Combustion
Engines
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Mixture Formation in Internal Combustion Engines

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Preface

A systematic control of mixture formation with modern high-pressure injection systems enables us to achieve considerable improvements of the combustion process in terms of reduced fuel consumption and engine-out raw emissions. However, because of the growing number of free parameters due to more flexible injection systems, variable valve trains, the application of different combustion concepts within different regions of the engine map, etc., the prediction of spray and mixture formation becomes increasingly complex. For this reason, the optimization of the in-cylinder processes using 3D computational fluid dynamics (CFD) becomes increasingly important.

This book may serve both as a graduate level textbook for combustion engineering students and as a reference for professionals employed in the field of combustion engine modeling.

The research necessary to write this book was carried out during my employment as a postdoctoral scientist at the Institute of Technical Combustion (ITV) at the University of Hannover, Germany. The text was accepted in partial fulfillment of the requirements for the postdoctoral Habilitation-degree by the Department of Mechanical Engineering at the University of Hannover.

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Nomenclature

Abbreviations

ATDC	after top dead center
B	Spalding transfer number
BMEP	break mean effective pressure
BTDC	before top dead center
CAI	controlled auto-ignition
CAN	controlled auto-ignition number

CFD	computational fluid dynamics
CI	compression ignition
CN	cetane number, cavitation number
CR	compression ratio, common rail
DDB	droplet deformation and break-up model
DDM	discrete droplet model
DI	direct injection
DISI	direct injection spark ignition
DNS	direct numerical simulation
EGR	exhaust gas recirculation
GDI	gasoline direct injection
HCCI	homogeneous charge compression ignition
HTO	high temperature oxidation
ICAS	interactive cross-sectionally averaged spray
IMEP	indicated mean effective pressure
K	cavitation number
KH	Kelvin-Helmholtz model
La	Laplace number
LES	large eddy simulation
LHF	lower heating value
LISA	linearized instability sheet atomization model
LTO	low temperature oxidation
M	third body species in chemical reactions
MEF	maximum entropy formalism
MW	molecular weight
NTC	negative temperature coefficient
Nu	Nusselt number