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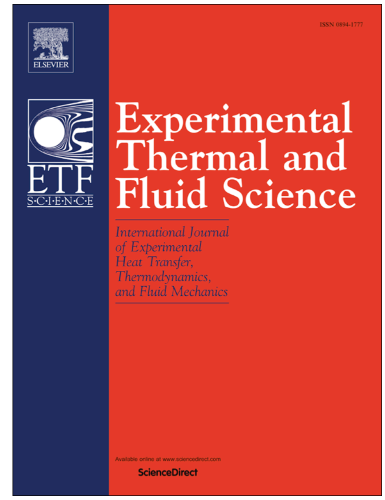

Exergy analysis of centered water nozzle steam–water injector

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ABSTRACT

A steam–water injector (SI), which is a passive jet pump, has been widely used in various industries. In the present work, exergy analysis models of a centered water nozzle SI were developed based on experiments to evaluate the performance of SI. The thermodynamic perfect degree of SI was found to be not so bad, and exergy efficiency was within the range of 18%–45%. In general, SI is used to work as a pump. However, exergy analysis can only evaluate the thermodynamic perfect degree of SI, but cannot evaluate its lifting–pressure performance. Therefore, thermo–mechanical exergy was divided into temperature–based exergy and pressure–based exergy in the present work, and the pressure–based exergy analysis was introduced. Such analysis was determined to be more reasonable than exergy analysis for a passive jet pump and helpful for achieving optimal SI design. Moreover, the effects of physical and geometric parameters on exergy efficiency and pressure–based exergy efficiency were investigated experimentally, and several optimal values for these geometric parameters were found. Finally, the distributions of exergy losses in separate parts of SI, particularly inevitable exergy losses, were evaluated. These analyses will be helpful in eliminating the effects of inevitable factors and in identifying the key factor, thereby considerably improving SI performance.

Keywords:
Steam–water injector
Exergy analysis
Pressure–based exergy analysis
Inevitable exergy losses

Nomenclature

A	area, m^2	α	exergy efficiency
c	velocity, m/s	β	pressure–based exergy efficiency
c_p	specific heat capacity, J/(kg·K)	γ	latent heat of vaporization, J/kg
D	diameter, m	δ	converging angle, °
e_h	specific thermo–mechanical exergy, J/kg	ε	area ratio
e_p	specific pressure–based exergy, J/kg	ζ	minor loss coefficient
e_t	specific temperature–based exergy, J/kg	η	isentropic efficiency of nozzle
E	exergy, W	ρ	density, kg/m^3
E_k	kinetic exergy, W	Φ	entrainment ratio
E_h	thermo–mechanical exergy, W	*Subscripts*	
E_L	exergy losses, W	0	steam/water nozzle inlet
E_p	pressure–based exergy, W	1	steam/water nozzle outlet
E_t	temperature–based exergy, W	2	mixing chamber outlet