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FUTURE PERSPECTIVES IN EJECTOR REFRIGERATION

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Abstract: Ejector chillers may represent a competitor for absorption chillers, as soon as their cost per unit cooling power becomes equal or lower. This target is not far from our present achievements. If input energy is waste or renewable heat, the system operating cost is mainly due to the investment in heat exchangers. Therefore, a cost reduction requires an increase of COP. This latter may be improved by a careful design of the ejector, which requires a deep insight into the thermodynamics and fluid-dynamics of its complex physics. The tools and the knowledge for an advanced design are already available and the improvement potential is significant.

Keywords: ejectors, refrigeration, CFD

Nomenclature

a	speed of sound [m s^{-1}]
c	velocity [m s^{-1}]
D	diameter
f	friction factor
h	specific enthalpy [kJ kg^{-1}]
HTC	heat transfer coefficient [W m^{-2} K^{-1}]
$\dot{m}$	mass flow rate [kg s^{-1}]
M	Mach number
Q	heating/cooling power [kW]
T	temperature [°C]
U	averaged velocity [m s^{-1}]
W	power [kW]

Greek symbols

ρ	density [kg m^{-3}]
τ	shear stress [kPa]
ω	entrainment ratio
Ω	section [m^2]

Subscripts

A	condenser exit
C	condenser entrance
$cond$	condenser saturation
E	evaporator exit
eva	evaporator saturation
f	cooling
G	generator exit
gen	generator saturation
m	motive
p	primary
s	secondary

1 Background

Supersonic ejectors are compression devices without moving parts, where a motive ("primary") flow exchanges momentum and mixes with an entrained ("secondary") flow. Ejectors can be used for a wide range of purposes, i.e. aeronautic propulsion, seawater desalination, suction of non-condensable gases in steam plants and compression of working fluid in refrigeration systems. This latter application, probably the most demanding in terms of efficiency, is our research topic. Any improvement in ejector efficiency would benefit the other ejector markets as well. Before any further statement, the basic constraints that affect a heat powered refrigeration system based on an ejector need to be pointed out.

1.1 Thermodynamic constraints

Any heat powered refrigeration system must comply with the efficiency limit given by a fully reversible

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