

# **High-Power Chemical Lasers (HPCL): Gas dynamics Problems of Mobile System Operation**

A. S. Boreysho, V. M. Malkov<sup>1</sup> and A. V. Savin

“Laser Systems” Ltd, 1<sup>st</sup> Krasnoarmeyskaya, 1, St. Petersburg 190005, Russia (www.lsystems.ru)

The main gas dynamics problems of HPCL development are discussed shortly. The creation methodology of Pressure Recovery System (PRS) for Supersonic chemical lasers and ways of increasing PRS efficiency are examined. Problems of Exhaust Supersonic Diffuser, Supersonic Ejector operation and question of PRS start process are investigated in details.

Supersonic chemical lasers – SCL (supersonic flow in resonator cavity that follows after mixing multi-nozzle bank): HF/DF laser and COIL – oxygen iodine laser are the subjects of high attention. SCL are the most powerful continuous wave laser systems. Today realization of mobile laser complexes - MLC on SCL base is actual question [1].

Operational pressure in SCL resonator cavity is low. So the development of Pressure Recovery System – PRS are required for SCL medium exhaust into atmosphere [2]. PRS development is one among the key problems of SCL - MLC realization.

PRS main parts are: multi-sectional exhaust supersonic diffuser-SD (with blowing system for start), supersonic ejector -EJ station (the multi-tunnel design of EJ is used to reduce the PRS length), vapor gas generator as the source of active gas for ejector (with storage and supply system -SSS of fuel and oxidizer). Mass-dimensional - M/S parameters of MLC are depended strongly on M/S characteristics of PRS with SSS. Therefore one can say the success in development of effective MLC is determined by success in solution of PRS problem.

PRS looks like a high-speed supersonic wind tunnel. However aerodynamics traditional integral methods for evaluation of PRS operational parameters don't work well. The main reasons are: the form of channel (SD channel of SCL is the rectangular with big side dimension ratio, aerodynamics wind tunnel channel is a round as a rule), heat generation in supersonic flow (it is absent in aerodynamics case), low Re numbers, active and passive gas in EJ are different from view point of the physical properties (in aerodynamics case gases are the same - air).

The modern methodology of PRS creation and ways of increasing of PRS efficiency are examined:

1. methods of choice and calculation of PRS parameters;
2. problem of verification of 3-dimensional numerical models;
3. methods of SD and EJ design taking in account the features of SCL physical processes (realization of COIL active diffuser concept and methods for mixing intensification of ejecting and ejected flows in ejector mixing chamber);
4. laser complex channel (wind tunnel channel is a simple channel) start processes and condition of PRS operation in general.

The dates of PRS, SD, EJ tests that are used for verification of numerical models are shown

[1] Shwarts J., Wilson G.T., Avidor J. “Tactical High Energy Laser”. Proc. SPIE **5632**, January 21 (2002)

[2] Boreisho A.S., Malkov V.M, Savin A.V. et al. “Pressure recovery systems for high-power HF/DF lasers: experience of realization”. Thermophysics and Aeromechanics **14**(4), 591-607 (2007)

---

<sup>1</sup> E-mail: malkov@lsystems.ru