the relation (5.3). Large number of experiments has been carried out. Typically observed cavity and plenum pressures are 5 mbar and 2 bar respectively. The estimated Mach number is 4.5, which is conducive for lasing action.

$$M = \sqrt{\left(\left(\frac{2}{\gamma-1}\right)\left(\left(\frac{P_0}{P_c}\right)^{\left(\frac{\gamma-1}{\gamma}\right)} - 1\right)\right)} \qquad (5.3)$$

Fig. 5.12 shows the typical temporal variation of Mach no. using analog input channels of developed DAS. The operating conditions were of cavity pressure 2.7 mbar and plenum pressure 1.5 bar.

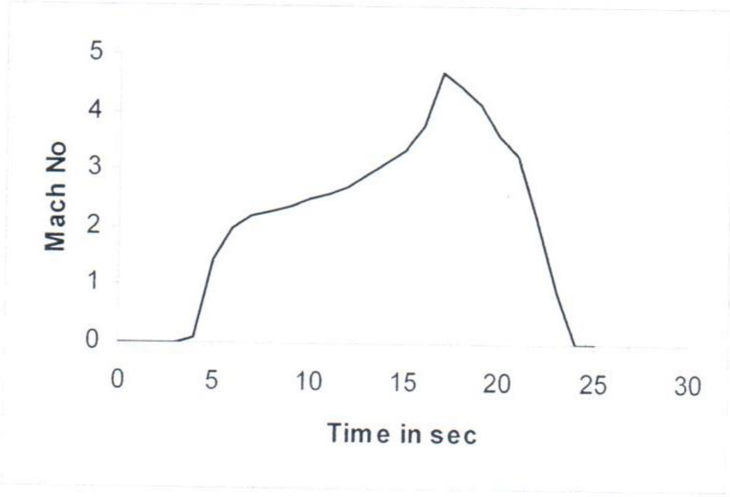

Fig. 5.12: Typical temporal variation of Mach number

It can be observed that though the Mach no. reaches 4.5 for a short time, but for longer durations it is of the order of 3. This implies that Laser pulse may be shorter than the designed duration. This aspect needs to be looked further.

The variation in Mach No with respect to hydrogen flow rate is shown in fig 5.13. The value of Mach no decreases immediately as soon as the hydrogen is injected into the cavity. This is mainly due to the reason that injection of hydrogen in cavity in the initial phases increases the cavity pressure thereby reducing the Mach no. It can be observed that the Mach no decreases from 5 to almost 3 with increasing hydrogen flow rates and then becomes almost stable there.

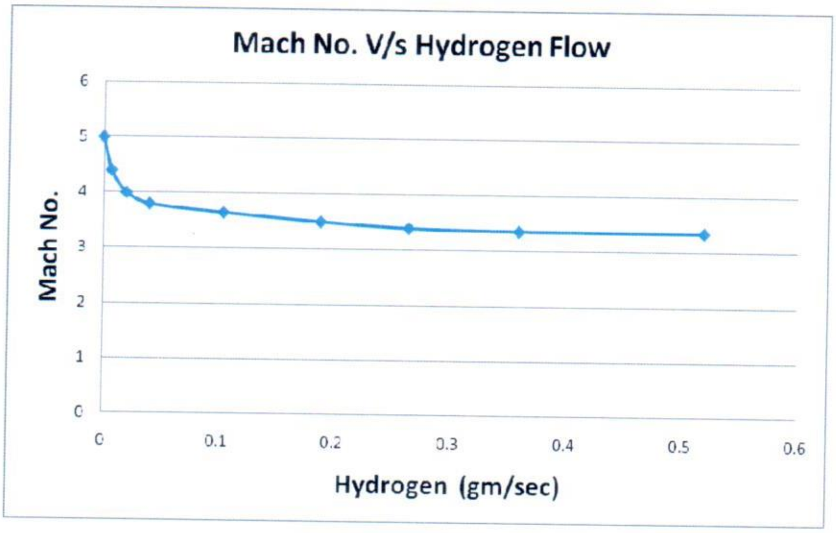

Fig. 5.13: Variation in Mach No. with H_2 addition

5. 5 Performance Evaluation of Arc Tunnel

The experimental parametric analysis for the developed arc plasma tunnel is highly time intensive where the final aim is to employ it for laser applications. Extensive experiments were carried out to establish the lasing parameters in 50 kW arc tunnel. Table 5.3 summarizes the results obtained in 50 kW arc tunnel.

N_2 flow (g/s)	SF_6 flow (g/s)	H_2 flow (g/s)	Voltage (V)	Current (A)	Power (kW)	Pl. Press. (kg/cm^2)	Pl. Temp. (K)	Cavity Pressure (mbar)	Mach No.
1.925	0.376	--	96	363	34.8	1.25	1693	2.7	4.94
2.778	1.8	--	102	353	36	1.68	1774	2.7	5.06
2.8	2.43	--	109	347	37.8	1.75	1740	2.7	5.18
5.085	0.969	0.188	97	405	39.53	2.046	1822	22.7	3.62
5.384	0.753	0.159	97.4	400	38.96	2.118	2000	34.6	3.35
6.213	0.714	0.264	98.8	405.5	40.2	1.732	2100	25.3	3.35
5.394	1.711	0.623	115	370	42.55	2.108	2100	45.3	3.16

Table 5.3: Arc Tunnel Experimental Results for Lasing

5.6 Conclusion

An experimental facility for a kW level HF/DF chemical laser has been setup. The design and development of 50 kW arc heater has been completed. The integration of arc tunnel components such as supersonic nozzle, cavity, diffuser and evacuation system with 50 kW arc heater has been successfully carried out.

It can be concluded that the 50 kW Arc heater is capable of handling flow rates for a kilowatt level HF laser. Further it can also be used for other arc driven lasers like carbon dioxide lasers.

The integration of Arc heater with other laser tunnel components and detailed experimentation reveal that the conditions are conducive for laser action. However some more experimentation and fine tuning particularly for achieving the right Mach no over a large duration is required.