SINGLE STAGE COMPRESSOR
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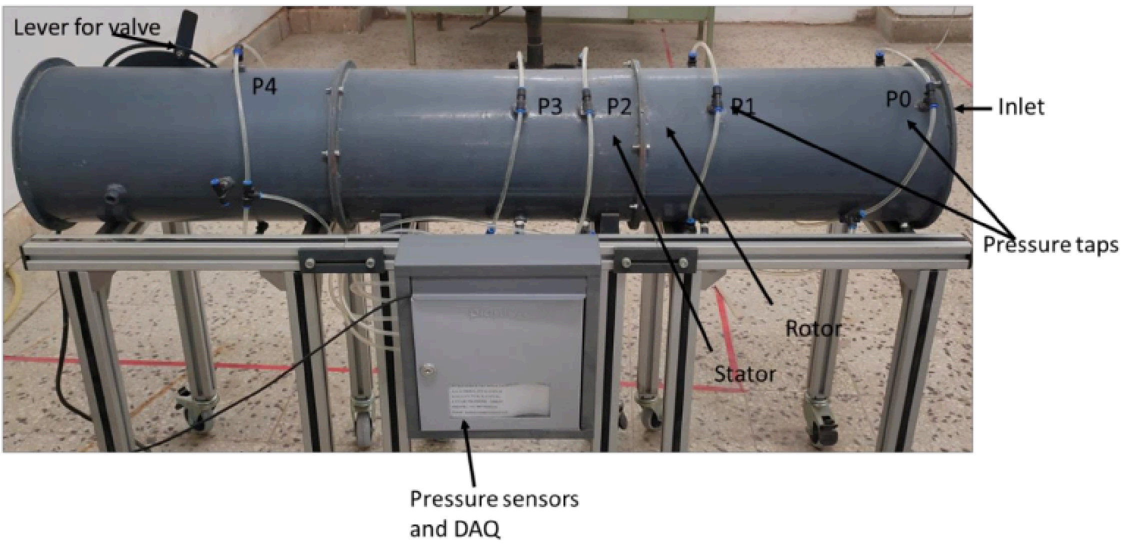
Objective:
To observe performance of Single Stage Compressor.

Apparatus:
- Single stage compressor setup (stagger industries)
- Variable frequency drive (VFD – FRECON)
- Data acquisition system (DAQ)
- Data recording device and software (LabView)
- Pressure sensors.

Experiment Setup



Observation Table

S.NO	RPM	P0(kPa)	P1(kPa)	P2(kPa)	P3(kPa)	P4(kPa)	Mass Flowrate
1	20	101.320	101.321	101.347	101.340	101.342	0.061
2	20	101.314	101.315	101.341	101.343	101.342	0.069
3	20	101.310	101.311	101.337	101.338	101.337	0.079
4	20	101.306	101.309	101.330	101.331	101.330	0.120
5	20	101.304	101.307	101.327	101.327	101.327	0.123
6	30	101.314	101.315	101.372	101.358	101.363	0.075
7	30	101.300	101.304	101.360	101.363	101.364	0.135

8	30	101.288	101.295	101.344	101.348	101.346	0.191
9	30	101.282	101.291	101.332	101.335	101.335	0.198
10	30	101.279	101.287	101.327	101.329	101.329	0.200
11	40	101.307	101.310	101.416	101.382	101.386	0.120
12	40	101.297	101.300	101.387	101.383	101.388	0.133
13	40	101.275	101.283	101.366	101.375	101.373	0.196
14	40	101.261	101.271	101.337	101.343	101.341	0.219
15	40	101.252	101.267	101.326	101.332	101.333	0.266

Calculation:

Formula Used :

- d=24 cm
- P_0=P_0_gauge+101325 (in pascal)
- Density = P / R*T
- Applying Ideal gas law: (At inlet, velocity=0)

P_0 = P_1 + 0.5*rho*v*v

$$V = \sqrt{\frac{2(P_0 - P_1)}{\rho}}$$

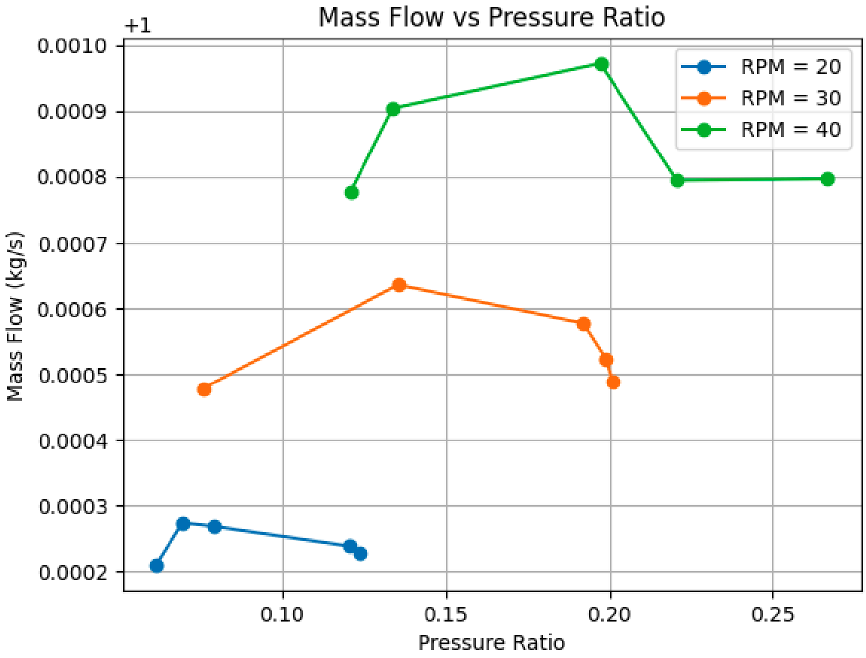
- Area of throat = Pi * d*d/4 = 0.04523 sq m
- Mass = rho * Area of throat * v

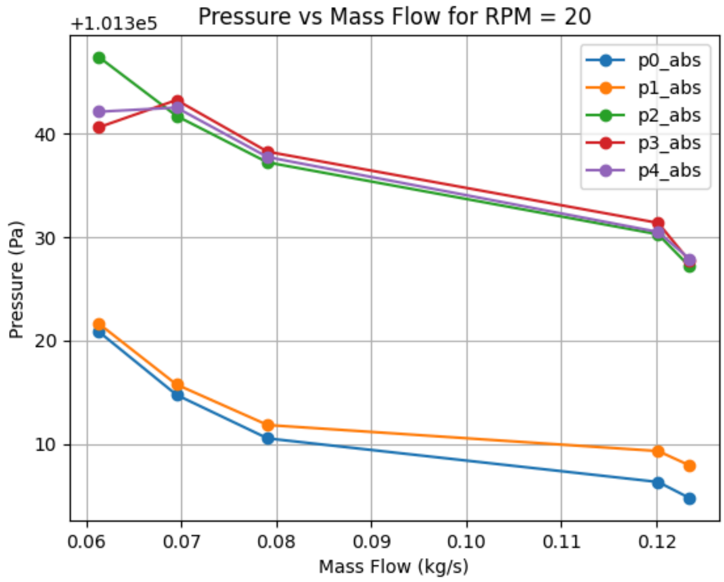
Application :

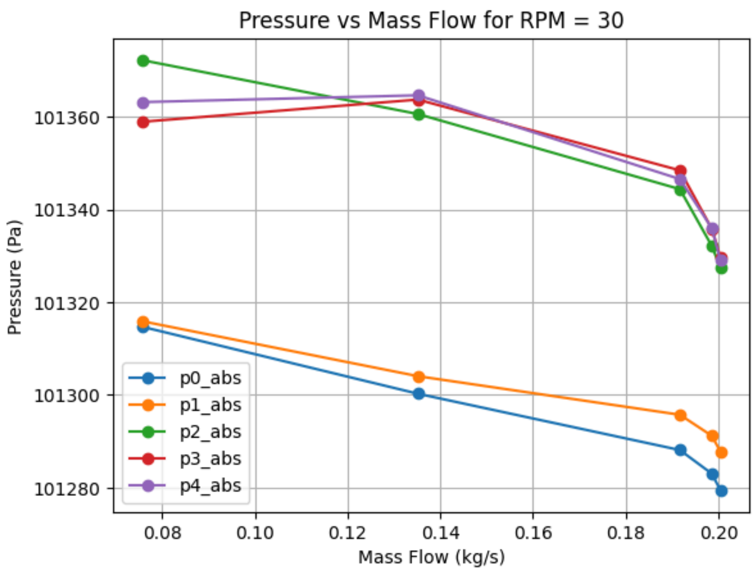
- For RPM=20
- P0_gauge = -4.18 (obtained from experiment)
  => P_0=101.32082 kPa
- P1_gauge=-3.4
  => P_1=101.3216 kPa
- v=1.1498 m/s
- Mass=0.06136 Kg/s

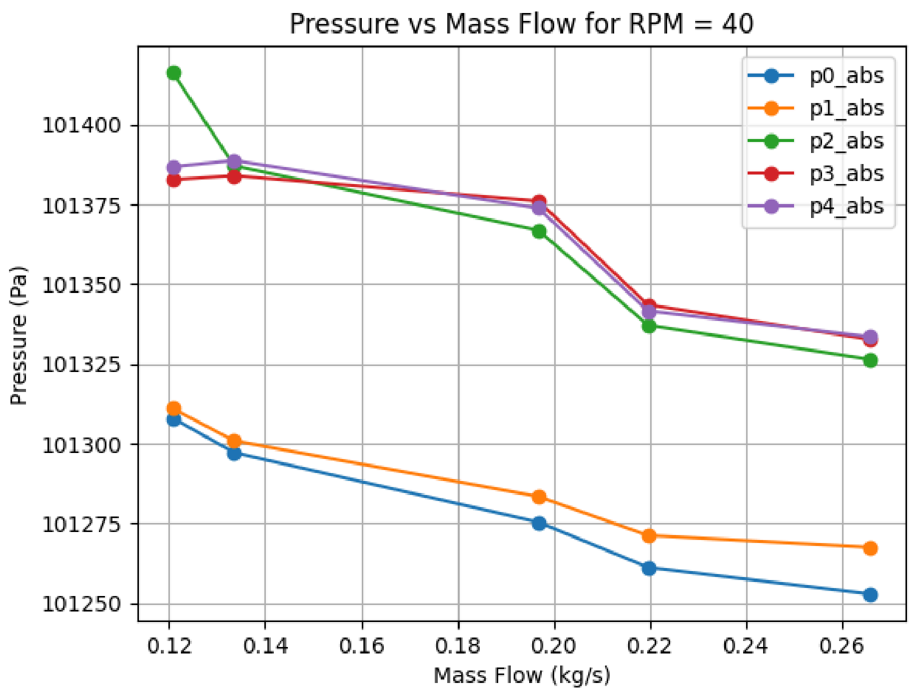
Graphs:

Mass Flow vs Pressure Ratio









Analysis:

- As RPM increases mass flow rate and pressure ratio also increases
- The pressure at inlet and pressure at before entering the rotor are lower than other pressure areas for all RPM
- P0<P1<P2<P3<P4 for all the positions in all RPM.
- Pressure ratio initially increases then decreases due to choking for all RPM

Conclusion:

In Single Stage Compressor performance is better at higher RPM