PH203 PROJECT

Calculation of Throughput and Pumping Speed in a Vacuum Chamber

N.V. Vineeth
2001CS49

Prabhjot Singh
2001CB39

Pratham Gupta
2001ME49

INTRODUCTION

In this project, we will study about throughput and pumping speed and how to calculate them using different parameters. We will deploy a web application interface and write a program for their calculation using two different methods i.e. using gas equation and the formula for pumping speed for a diaphragm pump.

Theory

THROUGHPUT (Q)

It is the quantity of gas flowing through a pipe per unit time. (Also sometimes, referred to as the product of pumping speed and the inlet pressure).

Unit: **Pa.m3/s = W**

Also, if **Q > 200D => Turbulent** and if **Q > 100D => Laminar**

PUMPING SPEED (Sp)

The volume of gas per unit time (dV/dt) which the pumping device removes from the system at the pressure existing at the inlet of the pump.

Unit: **litres/s, m3/hr**

CALCULATIONS

Using Gas Equation

Throughput (Q) = P * (d(V)/d(t))

=> **Q = (dN/dt) * (R.T)**

Pumping Speed (S) = Q / P

where,

n = Moles of Gas, P = Pressure,

T = Temperature, t =Time

CALCULATIONS

For a Suction Chamber

Throughput(Q) = $q_p V$

$\Rightarrow$ **$Q = n * (V_s * p_{in} - V_{D.S} * P_{out})$**

Pumping Speed (S) = Q/p_{in}

where, N = Rotational Speed

V_s = Suction Chamber Volume

P_{in} = Input Pressure

$V_{D.S}$ = Dead Space Volume

P_{out} = Output Volume

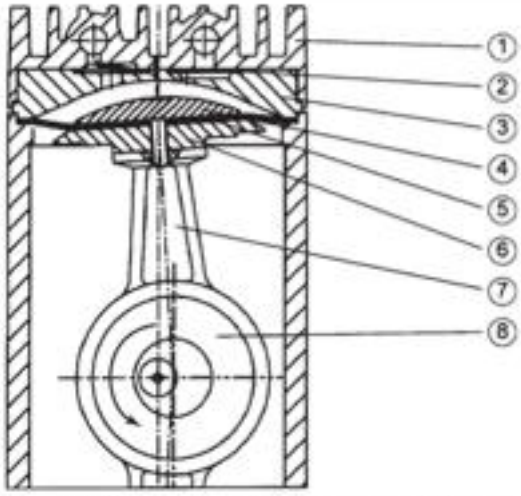


Figure 7.3 Diagram of a diaphragm pump stage: ① housing, ② valves, ③ head cover, ④ diaphragm clamping disk, ⑤ diaphragm, ⑥ diaphragm supporting disk, ⑦ connecting rod, ⑧ eccentric rotor (crank shaft).

CODE ANALYSIS

For Gas Equation

```
var throughput = (inputs[0].value * 8.314 * inputs[2].value) /
inputs[3].value;
var pumpingSpeed = throughput / inputs[1].value;
```

where,

input[0] = Moles of gas, input[1] = Pressure,

input[2] = Temperature, input[3] = Time

CODE ANALYSIS

For Suction Chamber

```
var throughput = inputs[0].value * (inputs[4].value * inputs[1].value -
inputs[3].value * inputs[2].value)
var pumpingSpeed = throughput / inputs[1].value
```

where,

input[0] = Rotational Speed, input[1] = Input Pressure,

input[2] = Output Pressure, input[3] = Dead Space Volume,

input[4] = Suction Chamber Volume

Links of the Code and the Deployed Website

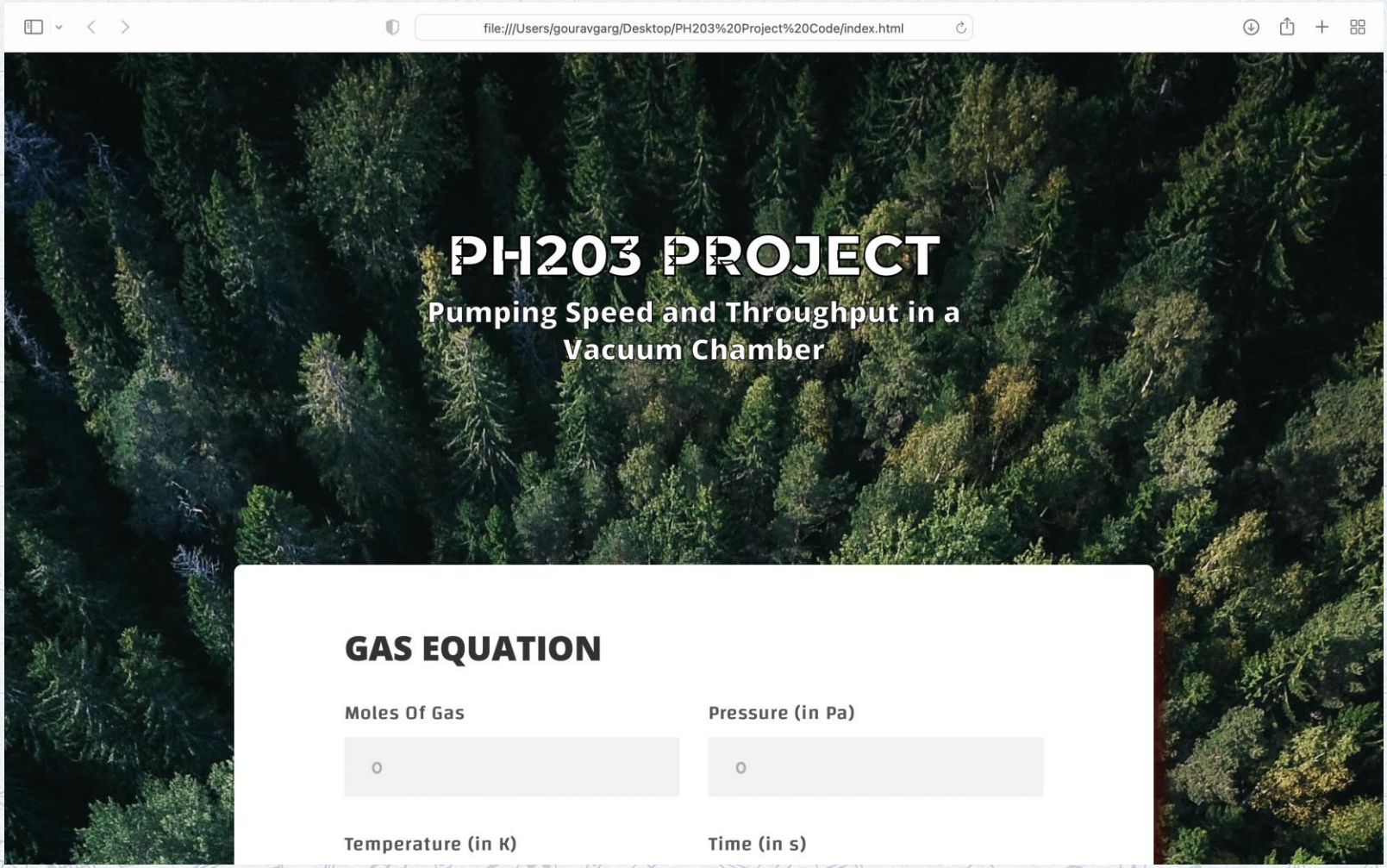
Link to the code and all related stuff (repository):

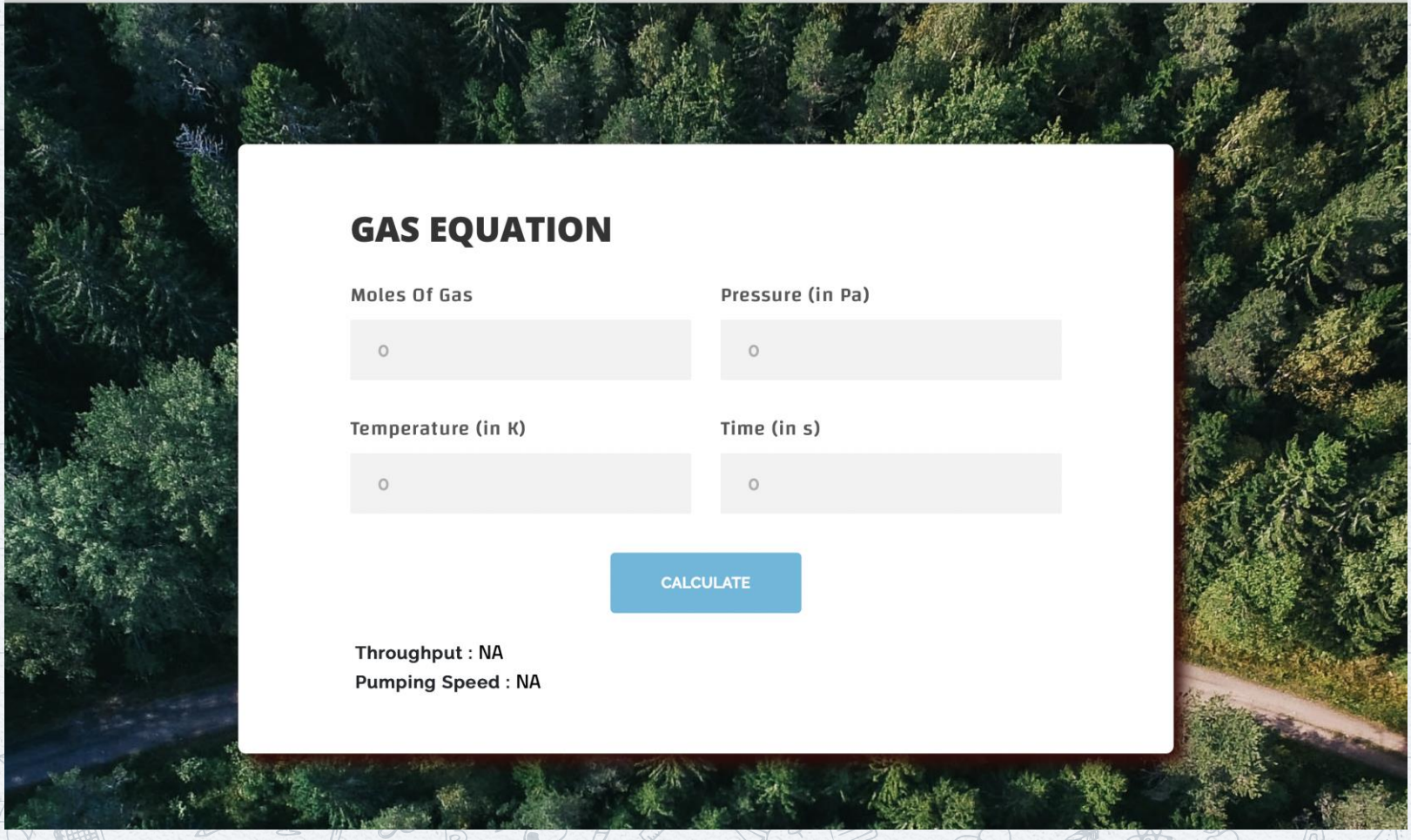
https://github.com/AryansinghBhati/vacuum

Link of the website deployed on netlify:

https://jazzy-youtiao-3b431e.netlify.app/

Screenshots
Of The Website Made


file:///Users/gouravgarg/Desktop/PH203%20Project%20Code/index.html
PH203 PROJECT
Pumping Speed and Throughput in a Vacuum Chamber
GAS EQUATION
Moles Of Gas
0
Pressure (in Pa)
0
Temperature (in K)
Time (in s)


file:///Users/gouravgarg/Desktop/PH203%20Project%20Code/index.html
GAS EQUATION
Moles Of Gas
0
Pressure (in Pa)
0
Temperature (in K)
0
Time (in s)
0
CALCULATE
Throughput : NA
Pumping Speed : NA

SUCTION CHAMBER

Rotational Speed

0

Input Pressure (in Pa)

0

Output Pressure (in Pa)

0

Dead Space Volume (in m^3)

0

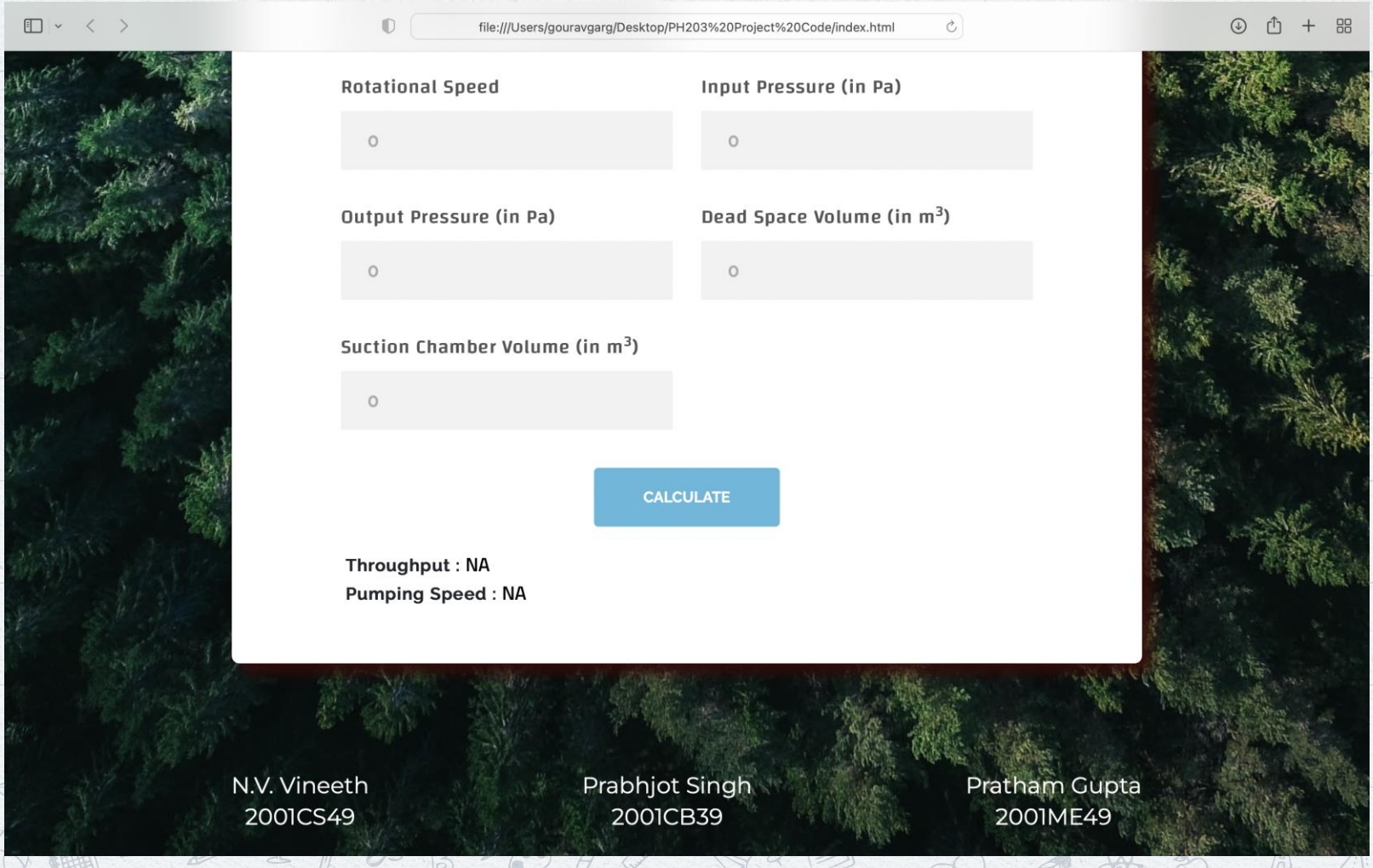
Suction Chamber Volume (in m^3)

0

CALCULATE

Throughput : NA

Pumping Speed : NA


file:///Users/gouravgarg/Desktop/PH203%20Project%20Code/index.html
Rotational Speed
0
Input Pressure (in Pa)
0
Output Pressure (in Pa)
0
Dead Space Volume (in m3)
0
Suction Chamber Volume (in m3)
0
CALCULATE
Throughput : NA
Pumping Speed : NA
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2001ME49

CONCLUSION

In this project, we studied about throughput and pumping speed and how to calculate them using different parameters. We also created a web application interface for calculation of throughput and pumping speed in a vacuum chamber. Many such soft-wares can be created for the ease of engineers that are useful in many cases.

So, at the end, we achieved our goal and wrote a program for the calculation of throughput and pumping speed successfully.

In two or three columns

Yellow

Is the color of gold, butter and ripe lemons. In the spectrum of visible light, yellow is found between green and orange.

Blue

Is the colour of the clear sky and the deep sea. It is located between violet and green on the optical spectrum.

Red

Is the color of blood, and because of this it has historically been associated with sacrifice, danger and courage.

PRABHJOT SINGH (2001CB39)

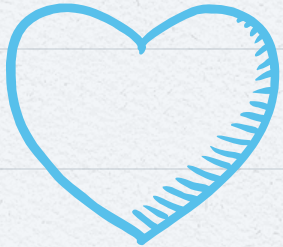
Understood the assignment and formed the basics of the project.

PRATHAM GUPTA (2001ME49)

Contributed in the development and the overall design of the website made.

N.V. VINEETH (2001CS49)

Contributed in the design framework and making of the report.



THANK YOU!

N.V. VINEETH
2001CS49

PRABHJOT SINGH
2001CB39

PRATHAM GUPTA
2001ME49