Analysis of Nozzle Tip of Mosquito Hit Spray

[1]Karthik.D, [2]Hemanth kumar.J, [3]Manikandan.R, [4]Chandrasekar.P

[1,2,3]Anna University, Rajalakshmi Engineering College, Student, Department of Mechanical Engineering, Thandalam, Chennai, India, Pincode-602105.
[4]Anna University, Rajalakshmi Engineering College, Assistant Professor, Department of Mechanical Engineering, Thandalam, Chennai, India, Pincode-602105.

Abstract- Nozzle is a device which converts the energy from a fluid into velocity of the spray droplets. Analytic report of nozzle at the mosquito spray under same pressure condition with different nozzle tip at design. This paper is helps to find flat shape or circular shape of nozzle tip shows increase in velocity and efficiency of the mosquito spray.

---

1. Introduction

A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe**.** A nozzle is often a pipe or tube of varying cross-sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In nozzle velocity of fluid increases on the expense of its pressure energy. The main objective is to perform computational fluid domain analysis to calculate velocity and pressure distribution in the nozzle. Fluid flow analysis was done on the nozzle to understand the velocity and pressure distribution. Applications in many industrial processes are numberless, with spray nozzles being very often a critical component in determining the final quality of the product or the efficiency of the process.

2. Application of nozzle analysis in mosquito spray

In the mosquito spray the coverage and the distance travelled by the fluid is is more important for the efficient spray. So, this is mainly influenced by the pattern and spray angle which is produced by the tip profile and also the distance coverage is influenced by the velocity of the nozzle.

Flat face profiled nozzle- These are used largely for broadcast spraying, where foliar penetration and coverage are not essential. The best operating pressure for flat fan nozzles is 15-30 psi, which produce coarser droplets that are not susceptible to drift.

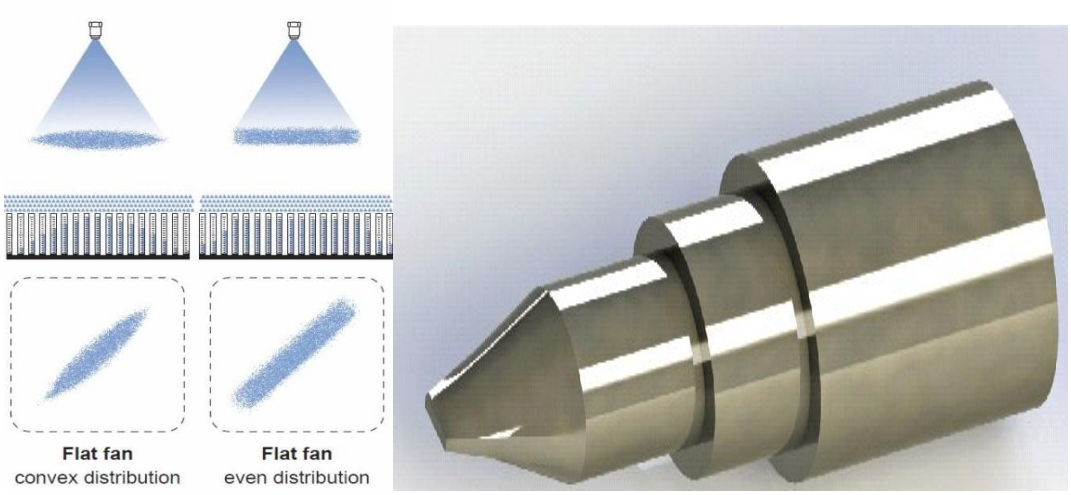
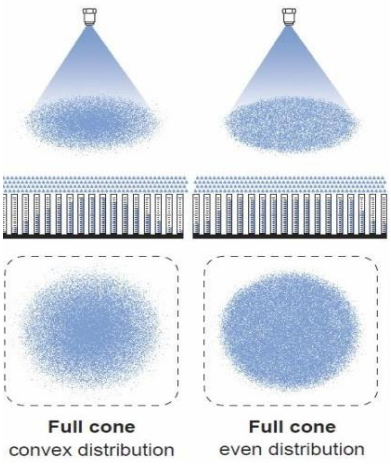


Fig.1 - Flat face profiled nozzle

Full cone nozzle tip- The full cone spray pattern is produced by grooves milled into the bottom of the nozzle which provide a defined deviation of the liquid flow to the mixing chamber's centre, whereby an extremely uniform area distribution of the atomized liquid is obtained.



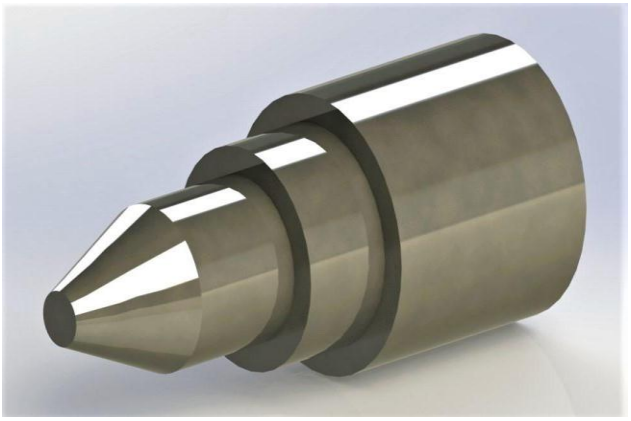


Fig.2 - Full cone nozzle tip

3. Theoretical calculation

1. **FINDING THE INITIAL PRESSURE OF THE NOZZLE.**

   $P_i = F/A_i$

   Where;

P_i – Initial pressure of the nozzle (pa)

F – Force (N)

A_i – Area of the inlet nozzle(m^2)

$F = m*g$ (N)

Where m – mass (kg); g – Gravity(m/s^2) therefore

$F = m*g$ m = 0.8kg; g=9.81m/s^2

F = 0.8*9.81 F = 7.848N round off **F=7.850N**

$A_i = \pi R_i^2$ (m^2)

Where R_i-Radius of the nozzle inlet end(m^2) R_i^2=.01m

A_i = 3.14*0.01^2

A_i = 3.14*10^-4 m^2

$P_i = F/A_i$

P_i = 7.850 / (3.14*10^-4)

P_i = 25000pa

2. **ASSUMING INITIAL VELOCITY:**

Let's consider the initial velocity since we don't know the required parameter so, **V_i = 0.005m/s**

Ansys report of both the nozzle-

1.Full cone nozzle:

Nozzle tip diameter =.2mm

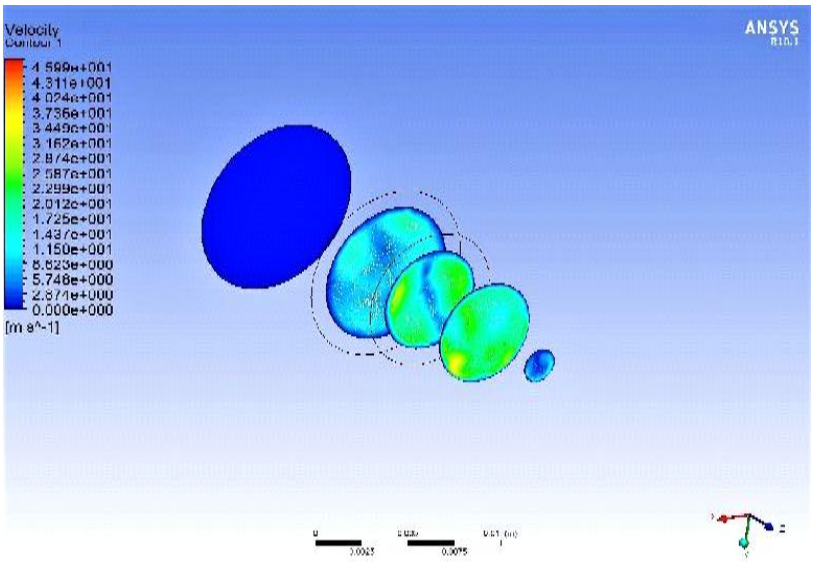


Fig.3 - Velocity contour

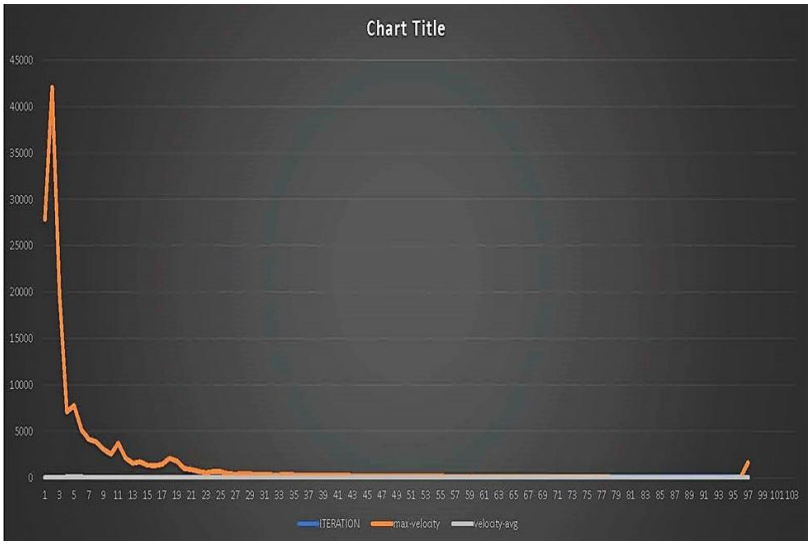


Fig.4 - Velocity graph

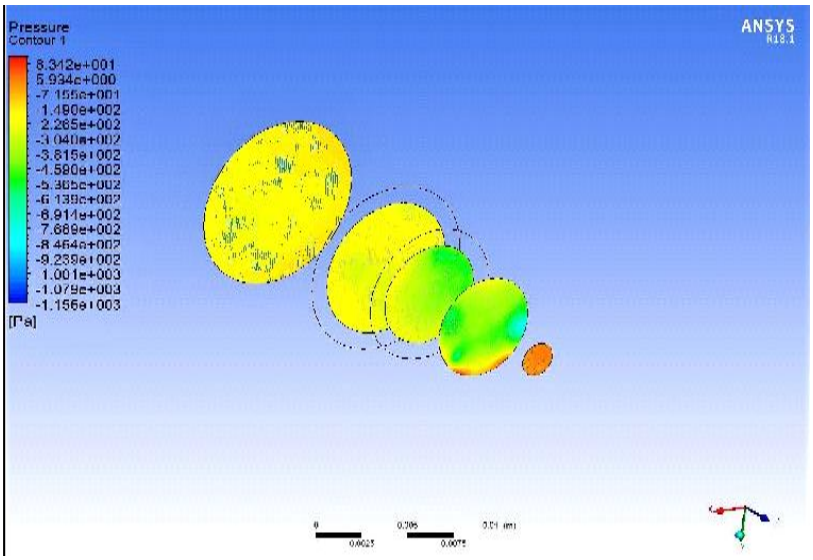


Fig.5 - Pressure contour

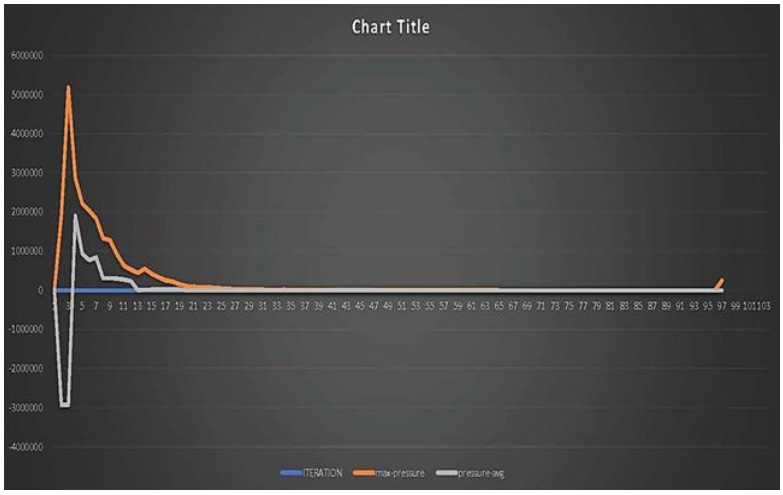


Fig.6 - Pressure graph

From the above graph and stimulation, we found that

Velocity maximum =30m/s.

Pressure maximum = 120pa.

Mass flow rate outlet =2g/s.

2.Flat face tip nozzle:

Nozzle tip diameter =.2mm

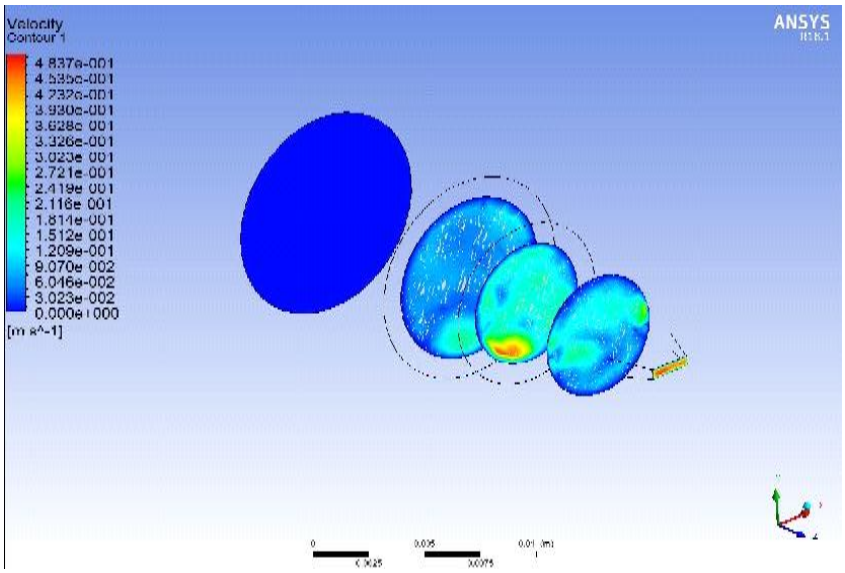


Fig.7 - Velocity contour

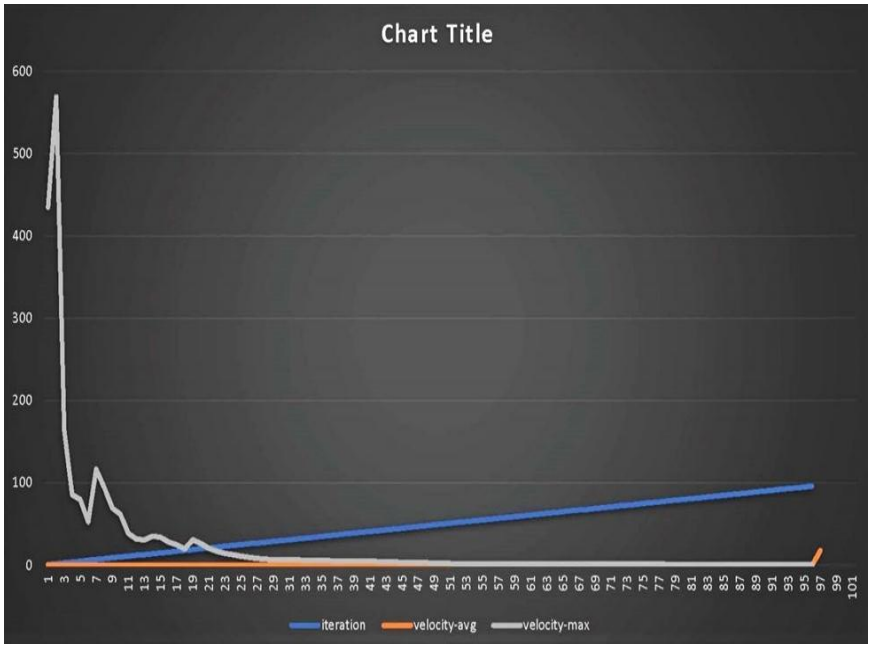


Fig.8 - Velocity graph

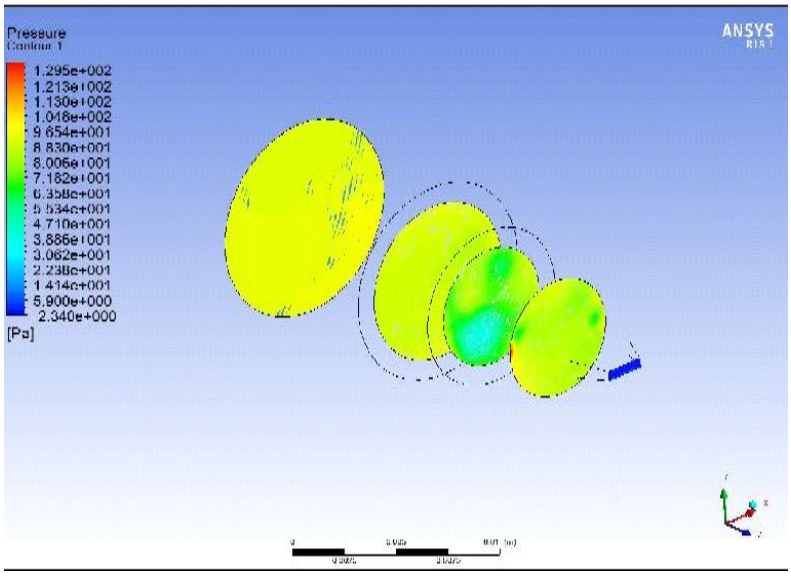
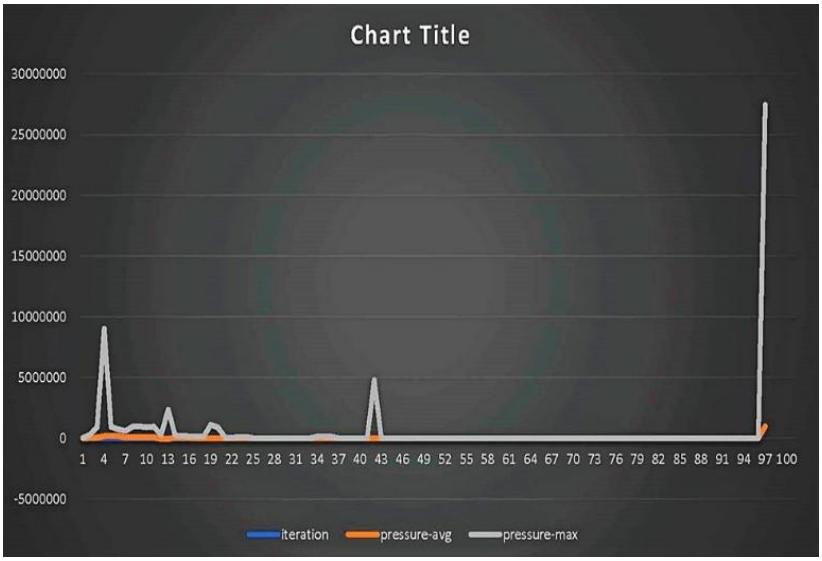


Fig.9 - Pressure contour:



Fig,10 -Pressure graph:

From the above graph and stimulation, we found that

Velocity maximum =18m/s.

Pressure maximum = 0.95bar.

Mass flow rate outlet =0.4g/s.

IV. Conclusion

From the above design and analysis we come to a conclusion that the mosquito hit spray is more efficient and also give the effective spray even if the inlet pressure and velocity is less, with circle end nozzle tip that's why the hand used spray bottle have the circle tip, whereas the flat end is used with motor in many industries and also in agriculture field for spraying pesticides and also the flat tip also able to spray for a wide area for about 140 – 170 degree so it's more suitable with motors and also achieve more velocity with less pressure. If we increase the area of the flat end nozzle tip then we can able to achieve the spray with less velocity but having a significant amount of mass flow rate. Whereas the circle end nozzle has more efficient even we reduce the nozzle tip size to 1mm of dimension, also we achieve a good result even we increase the size to 3mm of tip dimension.

References:

[1]"Experimental Investigation and Numerical Analysis on Water Jet Nozzle" by Srikanth Reddy. Ijmetmr.

[2]"Nozzle design (converging/diverging - CD nozzle)" by NASA.

[3]"Experimental Research on Flow Development and Control Effectiveness in the Duct at High Speed" by S. A. Khan, Zaheer Ahmed, Abdul Aabid, Imran Mokashi.

[4]"Flow Analysis and Manufacturing Process Plan of a Water Jet Nozzle" by G.Srikanth Reddy, J.Govardhan, P. Akshay Kumar.

[5]"Modelling and Simulation of Supersonic Nozzle" by Jyoti Kumari, C. S. Koli.

[6]"Numerical simulation of turbulent compressible flows in a C-D nozzle with different divergence angles" by Mohammad Hadi Hamedi Estakhrsar, Mehdi Jahromi.

[7]"Nozzle Selection and sizing" by Robert, Pat Hipkins.