

Study and Utilization of Oobleck Speed Breaker

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Abstract:- Oobleck is one of the Non Newtonian fluid i.e., (shear stress is indirectly proportional to the velocity gradient). Oobleck speed breaker changes its state of nature with respect to the speed of the vehicle and it behaves like a solid for an over speeding vehicle and a liquid for low speed vehicle travelling on a roadway. A Non-Newtonian fluid, as a viable material for constructing speed breaker. Oobleck, comprising a mixture of cornstarch and water, exhibits unique rheological properties, transforming from liquid to solid-like behavior under pressure. Through laboratory experimentation and field trials, this research investigates the mechanical characteristics, durability and environmental impact of oobleck speed breaker in comparison to conventional alternatives. Result indicates that oobleck speed breakers effectively reduce vehicle speeds while maintaining durability and sustainability. Moreover, economic and environmental analyses reveal the potential benefits of adopting oobleck speed breakers, including reduced material usage and carbon footprint. This study underscores the potential of oobleck speed breakers as an innovative, ecofriendly solution for traffic management, offering opportunities for enhancing road safety and promoting sustainable urban development.

Keywords:- Honey, Blood, Toothpaste, Paint, and Shampoo.

I. INTRODUCTION

Oobleck is a fluid material and which is a blend of corn-starch and water that behaves like a liquid or a solid depending on how much force applied. It is a ratio that can be used to formulation of oobleck material is 1:1.25. It is a suspension, or a substance that can mimic the qualities of a solid or a liquid. These materials are also classified as non-Newtonian fluids. A Newtonian fluid has a constant viscosity, such as water or gasoline. The main idea behind the Non-Newtonian fluid speed bump is that if a vehicle were to traverse it slowly, then the Non-Newtonian fluid would act more like a fluid and “deform” around the shape

of the vehicle thus eliminating the risk of damage to it, and when the vehicle were to travel at a high velocity, then the Non-Newtonian speed bump would suddenly harden” and become a solid effectively acting like a conventional speed bump and that would then punish the speeding vehicle and is to prevent the fatal accidents also it's not create a noise pollution as compared to conventional speed breaker.

Chemical formula of Cornstarch: - $C_{27}H_{48}O_{20}$

Molecular Weight: - 692.661 g/mol.

Density of Cornstarch: - 1.5g/cm³

II. LITERATURE REVIEW

➤ *Non-Newtonian Fluid Speed Breaker Prof.Pooja J. Chavhan, Runal Pawar, Shruti Donode, Rehan Pathan, Himanshu Damahe, Jan 2019*

The Non-Newtonian fluid Speed Breaker helps in increasing the fuel efficiency of vehicles up to a large extent its helps to test was carried out such as viscosity test and vehicle speed test.

➤ *Application of Oobleck as a Speed Breaker S. Revathi, A. Senthil Kumar, March 2020*

Oobleck Speed breaker changes its state of nature with respect to the speed of the vehicles as per vehicle speed testing.

➤ *Study and Analysis of Non-Newtonian Fluid Speed Bump Atul Bambore, Akshta Kharkar, Mukul Hatwade 2014,*

Non-Newtonian materials have a considerable potential to improve road safety for performing the viscosity testing.

➤ *Non-Newtonian Fluid Speed Bump Tanmay Mhatre, Sumit Maji*

To minimize the speed of the automobiles ensuring the welfare of citizens thus reducing fatal accidents reliable to performing a shear stress test as well as vehicular testing.

➤ *Reading and Analysis of Non-Newtonian Speed Bumps*
Dr. P.S. Lanjewar, Jankiprasad Lilhare, Rakesh Piprewar, May 2022

The Non-Newtonian fluid Speed Breaker help in increasing the fuel efficiency of vehicles up to a large extent with the help of executing the viscosity testing.

III. AIMS & OBJECTIVES

➤ *Aim:-*

- To study the behavior of Oobleck material under loading.
- To understand the rheological properties of Oobleck material.
- To perform a Vehicle speed testing of Oobleck speed breaker.
- To apply the Oobleck mixture for a speed breaker and about its characteristics or properties.

➤ *Objectives:-*

- To develop the Non-Newtonian fluid.
- To develop the prototype of Oobleck speed breaker.
- To evaluate the performance of Oobleck speed breaker.
- Comparison between Oobleck speed breaker and conventional speed breaker.

IV. TESTING CARRIED OUT

➤ *Viscosity Testing*

- Viscosity is defined as the property of fluid which occur resistance to the movement of one layer of fluid over and adjacent layer.
- This process of viscosity due to cohesion and molecular momentum exchange between fluid layers and as flow occurs.
- As per shear stress, these effects appear as shearing stresses between the moving layers of liquid.
- The top layer causes a shear stress on the adjacent lower layer while the lower layer causes the shear stress on the adjacent top layer.
- This shear stress is proportional to the rate of change of velocity with respect to distance.
- As per viscosity test, the relative viscosity and atmospheric temperature is inversely proportional to each other.
- The apparatus used in this test is viscometer.

➤ *Vehicle Speed Testing*

- In a vehicle testing, the flexible tubes are filled with a Non Newtonian fluid. If the vehicle travels at a low speed, fluid is moves and breaker is deformed, depression of the strip occurs in the area in which the wheels pass over, forming a small obstacle to the passage of the vehicle.
- However, if the speed of the vehicle is high then the fluid has no time to displace and a considerably smaller

depression occurs.

- A Non-Newtonian fluid is a fluid the viscosity of which varies with the pressure gradient applied.
- The fluid material acts as a solid and the speed breaker substantially retains the speed breaker shape.
- The speed breaker in this scenario acts similarly to a conventional speed breaker and the driver of the vehicle exceeding the selected speed limit will experience a breaker or jerk as would be felt with a conventional speed breaker.
- Drivers must always slow down when driving over the conventional speed breakers to prevent damage to their vehicle. However, the Non Newtonian fluid speed breaker is sensitive to the speed of the vehicle. The vehicle needs to slow down only if it is over speeding.

➤ *We have Developed two Prototype Models:-*

- 38.2cm x 16.5cm x 10 cm
- 2.7m x 0.4m x 0.1m

➤ *Shear Stress Calculation*

- Its unique property is that it behaves as a solid when subjected to sudden force or high shear stress, like hitting or squeezing, but as a liquid when the force is gentle or applied slowly. This behavior can be explained by its shear-thickening property: the faster or harder you apply force, the more resistance it gives.
- When you create a "speed bump" with oobleck, it can resist high shear stresses caused by fast or forceful movement (like a wheel rolling quickly over it). At high speeds, the particles in oobleck quickly lock together, creating a solid-like barrier, which can make it feel like driving over a solid object. But if you move slowly over it, the oobleck flows more easily and behaves like a liquid, creating little resistance.
- This interaction with shear stress is why oobleck acts differently than typical liquids, and why it could act as a speed bump that's effective only at higher speeds or forces.

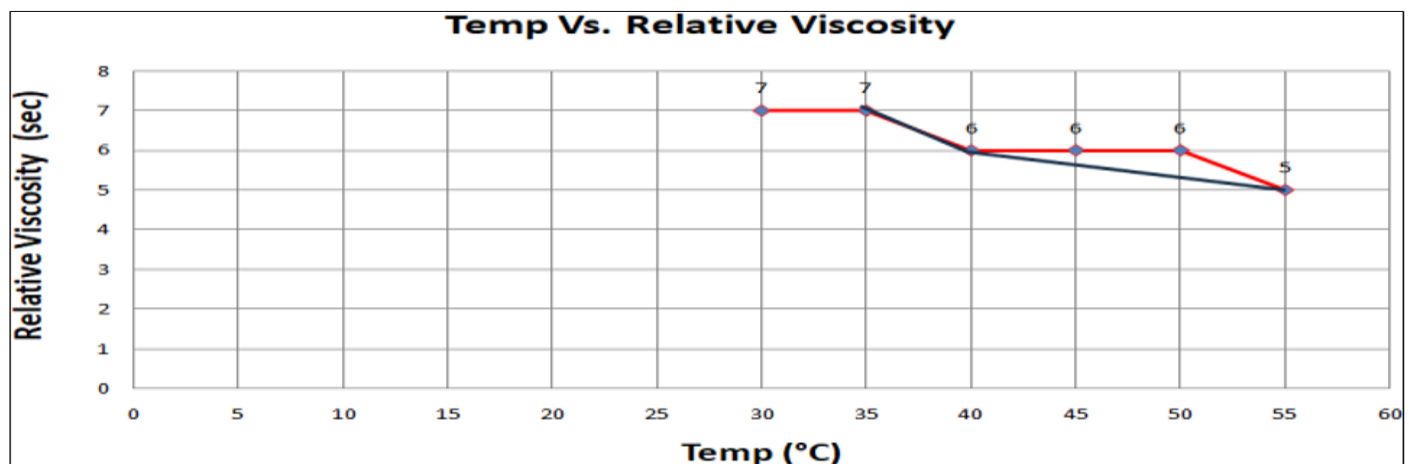
V. RESULT AND DISCUSSION

➤ Result on Viscosity Test

Table 1 Result on Viscosity Test

Sr. No.	Temperature in °C	Relative Viscosity (sec)	Kinematic Viscosity (centistokes)
1	Room Temp 30°	7	19.04
2	35°	7	19.04
3	40°	6	16.32
4	45°	6	16.32
5	50°	6	16.32
6	55°	5	13.6

➤ Graph:-



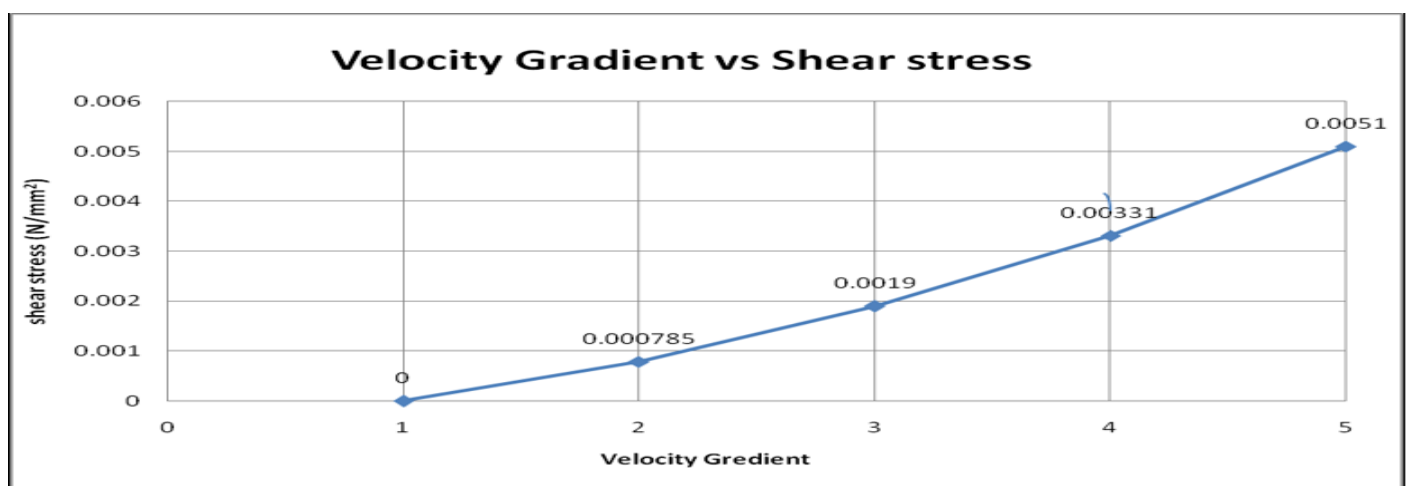
Graph 1 Temp Vs. Relative Viscosity

➤ Result on 2 Wheeler Vehicle Speed Testing and Shear Stress Calculation

Table 2 Result on 2 Wheeler Vehicle Speed Testing and Shear Stress Calculation

Sr. no	Distance (m)	Speed (kmph)	Speed (m/s)	Time (sec)	Acceleration (m/s ²)	Force (N)	Shear stress (N/mm ²)	Velocity gradient (s ⁻¹)
1.	20	20	5.56	6.23	0.89	10680	9.88×10^{-3}	3.92×10^{-4}
2.	20	30	8.33	5.35	1.55	18600	0.017	6.75×10^{-4}
3.	20	40	11.11	4.28	2.59	31080	0.028	1.11×10^{-3}
4.	20	50	13.89	3.42	4.06	48720	0.045	1.78×10^{-3}

➤ Graph:-

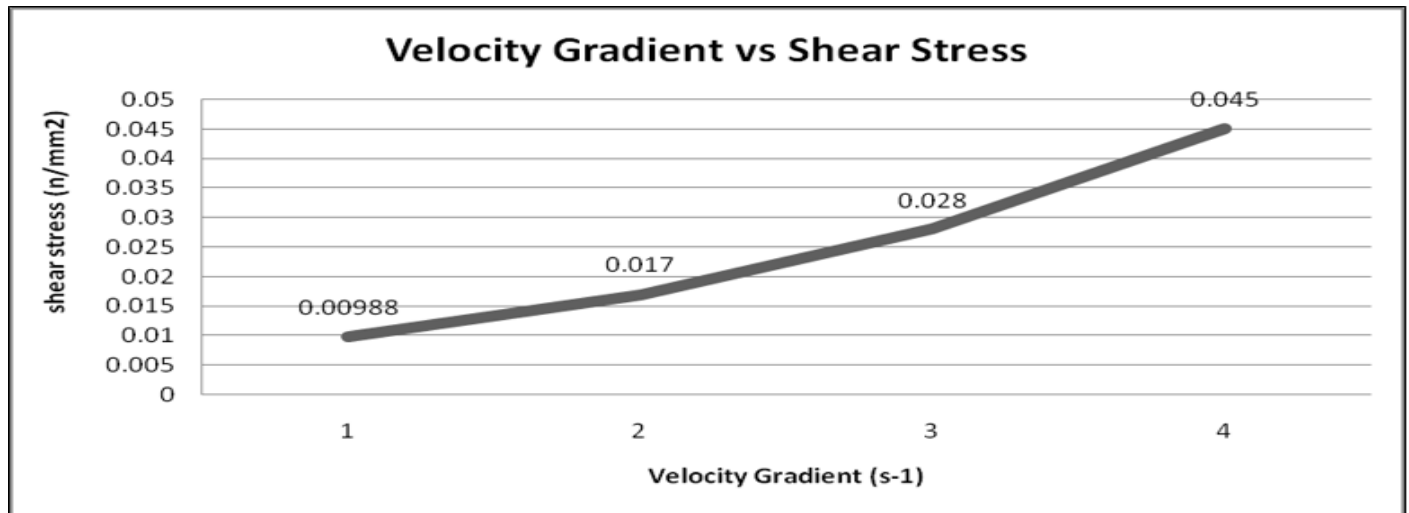


Graph 2 Velocity Gradient vs Shear Stress

➤ *Result on 4 Wheeler Vehicle Speed Testing and Shear Stress Calculation*

Table 3 Result on 4 Wheeler Vehicle Speed Testing and Shear Stress Calculation

Sr. No.	Distance (m)	Speed (kmph)	Speed (m/s)	Time (sec)	Acceleration (m/s ²)	Force (N)	Shear stress (N/mm ²)	Velocity Gradient (s ⁻¹)
1.	20	10	2.78	6.34	0.483	49.49	7.85×10^{-4}	3.12×10^{-5}
2.	20	20	5.56	5.23	1.06	119.78	1.90×10^{-3}	7.55×10^{-3}
3.	20	30	8.33	4.48	1.85	209.05	3.31×10^{-3}	1.31×10^{-4}
4.	20	40	11.11	3.89	2.85	322.05	5.10×10^{-3}	2.03×10^{-4}
5.	20	50	13.89	2.15	6.46	729.98	0.011	4.37×10^{-4}

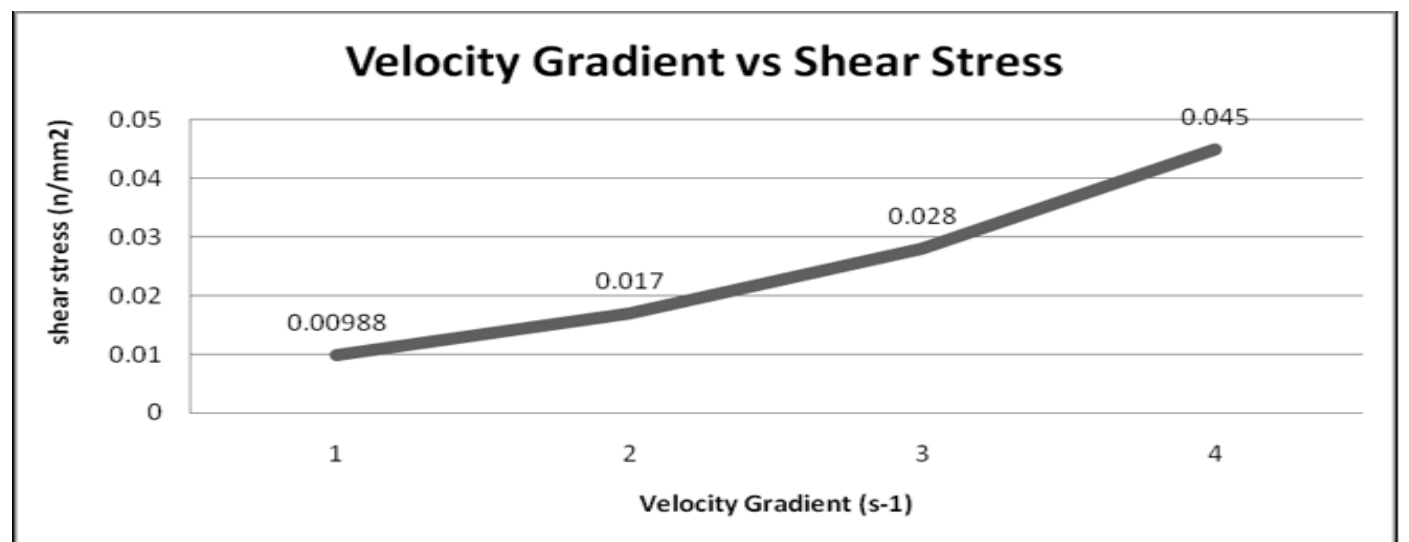
➤ *Graph:-*

Graph 3 Velocity Gradient vs Shear Stress

➤ *Result on Buses and Shear Stress Calculation:-*

Table 4 Result on Buses and Shear Stress Calculation

Sr. No.	Distance (m)	Speed (kmph)	Speed (m/s)	Time (sec)	Acceleration (m/s ²)	Force (N)	Shear stress (N/mm ²)	Velocity gradient (s ⁻¹)
1.	20	20	5.56	6.45	0.86	731	6.76×10^{-4}	2.68×10^{-3}
2.	20	30	8.33	5.18	1.60	1360	1.25×10^{-3}	4.96×10^{-3}
3.	20	40	11.11	4.38	2.53	2150.5	1.99×10^{-3}	7.91×10^{-3}
4.	20	50	13.89	3.55	3.91	3323.5	3.07×10^{-3}	1.22×10^{-4}

➤ *Graph:-*

Graph 4 Velocity vs Shear Stress

➤ *Figure*



Fig 1 Oobleck Material



Fig 2 Speed Bump

➤ *Viscosity Testing*



Fig 3 Viscosity Test

➤ *Speed Bump Testing*

Fig 4 Speed Bump Testing Salim

VI. CONCLUSION

- We understood about this oobleck material through viscosity testing such as, the atmospheric temperature will be increases but the relative viscosity is remains constant.
- In graph, temperature vs. relative viscosity shows that, the straight line is represent as the relative viscosity is remains constant with respect to atmospheric temperature and the curve line is represent as the atmospheric temperature is increases but the relative viscosity is near about decreases.
- In vehicle testing, the shear stress is inversely proportional to velocity gradient.
- According to both test, it is safe for designing the speed breaker on a road.
- The oobleck speed breaker is designs for ODR.

OBSERVED POINT

- Ater passing the vehicle, the breaker regain to its original shape.
- A Non-Newtonian fluid has a constant viscosity.
- This speed breaker is a light weight as compared to conventional speed breaker

FUTURE SCOPE

- It is suitable for light & heavy commercial vehicles.
- It can be installed on Major District roads.
- It gives reliable results for mixed traffic flow.
- It gives better performance in all weather conditions.

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