

Application of Oobleck as a Speed Breaker



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Abstract: A fluid in which the shear stress is directly proportional to strain, then it is termed as a Newtonian law of viscosity. If a fluid which does not obeys this law, then it is named as a Non-Newtonian fluid and Oobleck is one of the non-Newtonian fluid i.e., (shear stress is indirectly proportional to the velocity gradient) and Oobleck is made by mixing the corn starch and boiled water in the appropriate ratio of 1:1.25 to get the non-Newtonian fluid property. Then, the mixture made is stored in water proofing packaging material i.e., Kevlar fiber and it is used as replacement of existing conventional speed breaker. The aim of this project is to apply the Oobleck mixture for a speed breaker, study about it's characteristics and compare it with Conventional as well as plastic speed breaker. It plays a major role in controlling the speed of the vehicle and helps in preventing the accidents. The Oobleck is stored as a packing material in Kevlar fiber which retains the properties of the inner material forever and is having low thermal conductivity and chemical reactivity. The result indicates that the usage of Oobleck in speed breaker is sensitive to the speed of the vehicles and cost of manufacturing Oobleck speed breaker is comparatively lower than the conventional speed breaker.

Keywords: Speed breaker, Oobleck, corn starch, traffic.

I. INTRODUCTION

Speed breaker is a device which is used to control the speed of the vehicles passing over them. Speed Ramp, Speed Bump, Speed tables and Speed Hump are the general classifications of speed breaker. It can be used majorly near schools, colleges and hospitals to slow down the speed of the vehicles and, so it is very ease to cross the road for children and senior citizen people. They are also placed near entry points of bridges, narrow roads and toll booths to ensure that drivers reduce their speed. Now a day, there are two forms of speed breaker are mostly used which are conventional speed breaker and plastic speed breaker. The usage of fluid in a speed breaker is not common thing in real time. Here the fluid is nothing but the Oobleck, it is an example for non-Newtonian fluid. A Non-Newtonian fluid is a fluid that changes its viscosity with respect to the force applied to them.

Manuscript received on February 10, 2020.

Revised Manuscript received on February 20, 2020.

Manuscript published on March 30, 2020.

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Retrieval Number: F7358038620/2020©BEIESP

DOI:10.35940/ijrte.F7358.038620

Journal Website: www.ijrte.org

II. STUDY

A. Basics of Speed Breakers

A speed breaker is a semi-circular shape hump surface across the roadway having width higher than the vehicle wheel base. An ideally designed speed breaker should satisfy the following requirements:

- it should not cause any vehicle damage and does not cause any discomfort to the drivers as well as the passengers those travelling along it.
- The speed breaker should not produce any detrimental vibrations or too much noise to the adjacent buildings.

B. Design of Speed Breakers:

Speed breakers are basically in 3.7-meter width and having a height of 0.7 meter and advisory crossing speed of 25 km/hr., Speed breakers may have to be repeated over a section to keep speeds low throughout in certain locations and it can be built in a regular interval of 0.1 meter to 0.12-meter center to center distance.

C. Problem Associated with Conventional Speed Breakers:

Conventional speed breaker is naturally an eternal structure on a roadway and it is difficult to remove conventional speed breakers. In order to remove that, it has to be broken up so that roadway also repaired during that time.

Conventional speed breakers can often cause spinal damage and backache due to the constant shocks suffered while passing over the speed breakers.

A toll on mechanical component will be happened only travelling over the conventional speed breakers.

The fuel efficiency will decrease while travelling over the conventional speed breakers and to end up the further problems it Oobleck Speed Breakers can be implemented.

D. Oobleck:

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.

Figure 2 shows the relationship between stress and viscosity, from this graph we inferred that Newtonian fluid is drawn in a constant straight line which indicates that the fluid does not change its viscosity irrespective of stress, but Non-Newtonian fluid indicates that the stress is proportional to the viscosity i.e. when stress get changes simultaneously the fluid viscosity will also get change. There are two different forms of Non-Newtonian fluid are dilatant and pseudo plastic. The dilatant is shear thickening fluid, which means that when a pressure is applied to the fluid, the viscosity may immediately increase. Oobleck is an example of dilatant fluid.



III. PREPARATION

Oobleck is defined as the mixture of corn starch and water in the ratio of 1:1.25 and at this proportion only the fluid will behave the shear thickening properties.

Before doing this preparation, we must do several precautions to resist the microbiological growth in the fluids are:

- The water taken are boiled above 100°C to kill the microbiological growth in a water.
- The corn starch must be oven dried before using them.

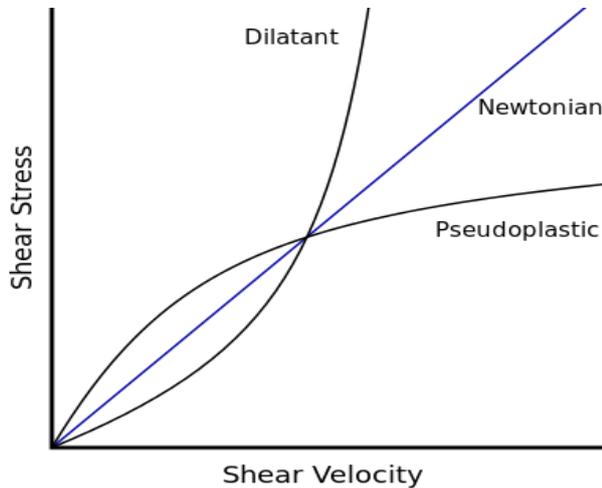


Fig 2: Relationship between shear stress and shear velocity

IV. PLACING METHOD

Then the made fluid are filled in a packaging material. Here we are choosing the packaging material as a Kevlar fiber and it can withstand high thermal stresses and impact load. The reasoning for choosing the Kelvar fiber as a packaging material because of its unique properties are:

- It has low thermal conductivity, so there is no heat transfer between the inner fluid and the surrounding environment.
- It has low chemical reactivity, so there is no any chemical reaction between the inner material and the Kelvar fibre.
- It is also less toxic in nature.
- It resists to ultra violet rays, oxygen and it does not support any microbiological growth therefore the properties of an inner material won't change forever.

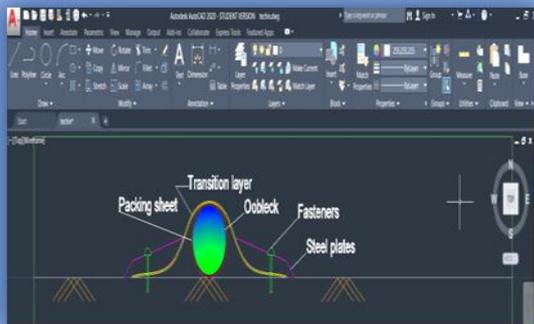


Fig 3: Placing method (Auto CAD diagram)

Figure 3 represents the placing method of a Oobleck speed breaker and we just drawn a model in an auto cad and the above picture, shaded region represents the Oobleck material

and it is filled in a packaging material i.e. Kevlar fiber and above this a transition layer is laid over and fastens on both the sides.

TABLE - I: Comparison between Conventional and Oobleck Speed Breakers

PARAMETERS	Oobleck Speed Breaker	Conventional Speed Breaker
Nature	Mobile	Permanent
Sensitivity	Sensitive	Not sensitive to speed of the vehicle
Efficiency of fuel	Increases	Decreases
Damage on Mechanical Components of Vehicle	No	Yes
Method of Installation	No highly challenging labour required	Highly challenging labour required
Medical Problem	No such problems	Spinal Damage or Aggravate Chronic Backache
Installation and maintenance Cost	Low	High

V. RESULTS

- The result indicates that the shear thickening properties will exhibit only in the ratio of 1:1.25 (corn starch : water) but in case, if we changed the ratio the non-Newtonian fluid property won't exists.
- Also, the fuel efficiency of vehicles gets increased while travelling over the Oobleck speed breaker.
- Also, there is no maintenance needed for this type of speed breaker.

VI. CONCLUSION

Oobleck speed breaker changes it state of nature with respect to the speed of the vehicle and it behave like a solid for an over-speeding vehicle and a liquid for low speed vehicle travelling on a roadway and it also behave like a road surface and it will give comfort while travelling over the speed breaker and the cost of manufacturing of Oobleck speed breaker is comparatively lower than the conventional as well as the plastic speed breaker and Oobleck speed breaker is mobile, we shift the speed breakers wherever we needed. Therefore, Oobleck speed breaker is an eco-friendly and economic friendly one to society.

REFERENCES:

1. Stockbower,R., The physics of Oobleck, Ars Technica, 2005
2. Rahul Bagchi, "Traffic calming measures", International Journal of Chemical, Environment and Biological Sciences (IJCEBS), Volume 1, 2013.
3. Hari Narayanan Soundararajan,,"Usage of Oobleck as a Packaging Material", International Journal of Scientific and Research Publications, Volume 3, Issue 3, March 2013.
4. Maths Carrers," Non-Newtonian fluids" 2011 [online] visited December 2012.
5. Seydim, A.C. and Dawson, P.L., Packaging Effects on Shell Egg Breakage Rates during Simulated Transportation, 1999 Poultry Science 78 148-151

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Mrs. S. Revathi, is Assistant Professor in Department of Civil Engineering. Her area of expertise is composite structures. She has published about 5 papers in reputed journals and also, she has presented about 12 papers in national and international conferences in reputed institutions. She is a life member of ISTE.



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