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Application of Oobleck as a Speed Breaker

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ABSTRACT: Traffic calming measures are crucial for enhancing road safety and reducing vehicle speeds in urban areas. Traditional speed breakers, often constructed from hard and rigid materials, can lead to noise pollution, vehicle wear and tear, and discomfort for passengers. In recent years, there has been a growing interest in exploring eco-friendly and innovative alternatives to conventional speed breakers.

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 1:3 to get the non-Newtonian fluid property as per speed limit requirement. 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 its 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: Oobleck speed breaker, Traffic controlling device, Speed breaker, Oobleck, Cornstarch.

I. INTRODUCTION

Speed breaker is a device which is used to control the speed of the vehicles passing over them. The challenge of road safety and traffic management has long been a matter of global concern. 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 easy 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. Traditional speed breakers, though effective in controlling vehicle speed, often come with drawbacks, such as noise pollution, increased fuel consumption, and wear and tear on vehicles. In the

search for innovative and sustainable solutions, Oobleck, a non-Newtonian fluid composed of water and cornstarch, has emerged as a fascinating and potentially ground breaking option for use as a speed breaker. This introduction explores the concept of using Oobleck as a speed breaker, discussing its unique properties and the potential benefits it may offer in enhancing road safety and sustainability.

II. STUDY

1. Basics of Speed Breakers

Speed breakers are raised sections of the road surface designed to slow down vehicles by creating discomfort, promoting safer driving in specific areas such as residential zones and school areas.

An ideally designed speed breaker should satisfy the following requirements:

- Speed breakers should be easily visible to drivers to ensure they can anticipate and slow down in advance.
- 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.
- They should have consistent dimensions and shape to ensure predictable behavior for drivers.
- The speed breaker should not produce any detrimental vibrations or too much noise to the adjacent buildings.
- The rise of the speed breaker should be gradual to minimize discomfort to passengers while effectively slowing down vehicles.

B. Design of Speed Breakers:

Speed breakers are basically in 3.7-meter width and having a height of 0.7 meter. The design of speed breakers involves creating raised sections of the road way surface with gradual inclines and declines, ensuring visibility and uniformity of speed breaker. They should be wide enough for vehicles, marked for visibility, strategically spaced, made of durable materials, and comply with regulations regarding height, width, and placement for safety and effectiveness.

C. Problem Associated with Conventional Speed Breakers:

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

Conventional speed breaker damage on mechanical components of vehicle and also decreases the fuel efficiency.

D. Oobleck:

Oobleck is a Non-Newtonian fluid which is made up of **corn-starch** and **water** with appropriate proportion that behaves like a liquid or a solid depending on the intensity of applied force.

Figure 1 shows the relationship between stress and viscosity of fluids, from this graph we inferred that Newtonian fluid is drawn in a constant straight line which indicates that the fluid constant its viscosity respective 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.

II. PREPARATION

Oobleck is define as the mixture of corn-starch and water in the ratio of 1:1.25 to 1:3 at this proportion only the fluid will behave the shear thickening properties i.e. that behaves like a liquid or a solid depending on the intensity of applied force.

- 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.

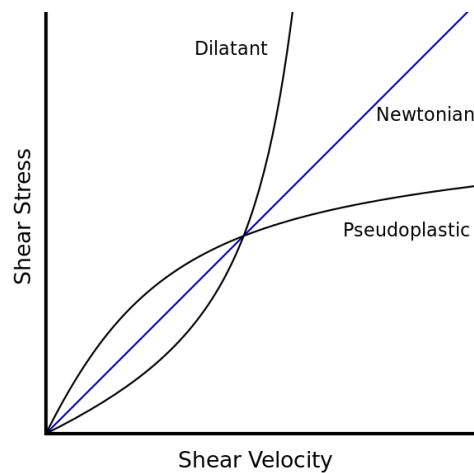


Fig 1: Relationship between shear stress and shear velocity

➤ Material Used for Oobleck speed breaker:

- Corn-starch
- Water
- Kevlar fiber

➤ Methodology:

- Collection of material
- Batching
- Mixing
- Prepare of Oobleck
- Packing in Kevlar fiber

- Placing of Oobleck speed breaker on road.

➤ **Equipment required:**

- Mixing bowl
- Spoon or whisk for stirring

III. PLACING METHOD

Making an oobleck speed breaker involves pouring a thick mixture of oobleck (cornstarch and water). Then the made fluid are filled in a packaging material. Kevlar fiber is selected for the packaging of fluid in desired shape due to their unique properties are as :

- Kevlar fiber has low thermal conductivity, which resist the transfer of heat into fluid present in fiber.
- It has excellent resistance to various chemicals, including acids and solvents, making it useful in various industrial applications.
- It has less toxic in nature.
- It resist the ultra violate rays, oxygen because absence of oxygen it does not support to the growth of microorganism there fore the properties of inner fluid never changes.
- Kevlar fiber is exceptionally strong, with a tensile strength five times stronger as compare to steel on the weight-to-weight basis.



Fig 2: Placing method (Auto CAD diagram)

Figure 2 represents the placing method of a Oobleck speed breaker. Above picture, shaded region represents the Oobleck material and it is filled in a packaging material i.e. Kevlar fiber and a transition layer is laid over Kevlar fiber and fixed on both the sides.

IV. COMPARISION BETWEEN CONVENTIONAL & OOBLECK SPEED BREAKER

PARAMETERS	Oobleck Speed Breaker	Conventional Speed Breaker
Materials	Oobleck	Concrete/Bitumen
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
Traffic noise pollution	Increases	Decreases

V. RATIO OF WATER & CORN-STARCH FOR DIFFERENT SPEED LIMIT

Making an oobleck speed breaker involves adjusting the ratio of cornstarch to water to achieve the desired viscosity and behavior. The ideal ratio can vary depending on factors such as the desired speed limit, ambient temperature, and specific properties of the cornstarch and water used. However, here's a general guideline to get you started:

- **Low Speed Limit (e.g., 5-10 mph ≈ 8-16 km/h):**
 - Start with a ratio of approximately 1 part water to 1.5-2 parts cornstarch.
 - This mixture should create a thick, viscous Oobleck that can effectively slow down vehicles traveling at low speeds.
- **Medium Speed Limit (e.g., 15-20 mph ≈ 24-32 km/h):**
 - Adjust the ratio to approximately 1 part water to 2-2.5 parts cornstarch.
 - This mixture should strike a balance between viscosity and flowability, suitable for vehicles traveling at moderate speeds.
- **High Speed Limit (e.g., 25+ mph ≈ 40+ km/h):**
 - Increase the cornstarch content to approximately 1 part water to 3 parts cornstarch or higher.
 - This mixture should create a thicker, more solid oobleck that can effectively slow down vehicles traveling at higher speeds.

Keep in mind that these ratios are starting points, and you may need to adjust them based on your specific requirements and experimentation.

VI. APPLICATIONS

1. Traffic calming measures in residential areas and school zones.
2. Temporary installations for events or construction zones.
3. Ensuring low-speed zones near hospitals or parks.
4. Environmentally friendly alternative to traditional speed bumps.
5. Adjustable viscosity for customizable speed control.
6. Platform for experimental research on traffic flow dynamics and road safety.

VII. RESULTS

1. Oobleck speed breaker helps to increase the fuel efficiency.
2. It provide smooth flow of traffic.
3. Installation cost and repair cost of Oobleck speed breaker is less than conventional speed breaker.
4. It does not injure parts of the cars mechanical components such as throttle cutters and steering system and also prevent the spinal damage if the car is following speed limit.
5. Less time required for installation.
6. Technical person is not required for installation.
7. Traffic noise can reduce by replacing the conventional speed breaker to the Oobleck speed breaker.

VIII. CONCLUSION

Oobleck speed breaker changes its state of nature depending on the speed of vehicle i.e. intensity of applied force. It behave like a solid for over-speeding and behave like liquid for slow speed vehicle passing on it. It does not gives impact to the vehicle which vehicle passing on it within speed limit and provide comfort travelling. Cost of installation and repair is less as compare to conventional speed breaker. Easy to installation and also not required of skilled labour for their installation.

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