VERSATILE BICYCLE
(AN AMPHIBIOUS VEHICLE)

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1. ABSTRACT

A versatile bicycle that runs both on land and water is to be designed and fabricated. High density thermocol blocks are used to create buoyancy force that makes the cycle float on water. The thermocol blocks are attached to the L-clamps. For the movement in water, paddles are fixed to the rear of the cycle that is connected to the rear wheel sprocket through chain drive. While riding on land, the L-clamp can be easily folded and locked. If necessary the thermocol blocks can be detached from L-clamp. Its useful is crossing back waters, lakes etc., can be used in flood days and also as water sport. Our project deals with solving the real time problems faced by people in India.

2. KEYWORDS

Bicycle, Amphibious, Versatile, Buoyancy, Thermocol, L-Clamps, Rotating paddles.

3. OBJECTIVE OF OUR PROJECT

- The main objective of our project is to modify a normal bicycle so that, it can be used both on land and water.
- We make sure that the modifications do not cause any unease to the rider and the comfort of riding on land is not reduced.
- To design and fabricate an eco-friendly amphibious vehicle to help the common people in India.

There are many parts in India as well as in world where water bodies like river, ponds, lakes etc. obstruct the roadways. In those areas, we have to carry the land vehicle in boat to cross the water body. This causes a lot of difficulties to the people and particularly the children who use bicycle as the means of transport. In states like Kerala, Goa etc. where the back water is common, the carrying of bicycles, motorbike and cars etc. by boat is also very usual. In those areas, it will be very useful to have an amphibious vehicle which can be used both on land and water.
VERSATILE BICYCLE

Versatile Bicycle in Swimming Pool (fig.1)  Versatile Bicycle on Land Mode (fig.2)

Versatile Bicycle on Land Mode (fig.3)  3-D Model of Versatile Bicycle (fig.4)
4. MATERIALS USED

<table>
<thead>
<tr>
<th>Material</th>
<th>Specifications</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>standard</td>
<td>1</td>
</tr>
<tr>
<td>Thermocol</td>
<td>density of 20 kg/m³, 200 mm thickness</td>
<td>4</td>
</tr>
<tr>
<td>M.S. Sheet</td>
<td>3mm thickness</td>
<td></td>
</tr>
<tr>
<td>M.S. Sheet</td>
<td>6 mm thickness</td>
<td></td>
</tr>
<tr>
<td>M.S. Sheet</td>
<td>1 mm thickness</td>
<td></td>
</tr>
<tr>
<td>Iron rod</td>
<td>Tempered, 6mm dia</td>
<td>4</td>
</tr>
<tr>
<td>Lorry hinges</td>
<td>Standard</td>
<td>4</td>
</tr>
<tr>
<td>Chain drive</td>
<td>Standard</td>
<td>2</td>
</tr>
<tr>
<td>Sprocket</td>
<td>Standard</td>
<td>2</td>
</tr>
<tr>
<td>Hub</td>
<td>Single side threaded</td>
<td>1</td>
</tr>
<tr>
<td>Hub</td>
<td>Double side threaded</td>
<td>1</td>
</tr>
</tbody>
</table>

5. THERMOCOL

Thermocol is one of the major raw materials of our project. Four blocks of thermocol are used to create buoyancy force that makes the cycle to float in water. The thermocol blocks are cut in aerodynamics shape to provide better displacement in water.

Before Cutting (Fig. 5.1)  
After Cutting (Fig. 5.2)
6. THE L - CLAMPS
The L-clamps are made of mild steel of thickness 3mm and 6 mm. The clamp is foldable and can be folded while operating the bicycle on the land. The folding is done by fixing hinges. The thermocol blocks can be fitted and locked by using bold and nuts. The thermocol can be attached or detached according to the riders wish. The supporting rod should be fitted while moving in water.

7. PROPERTIES OF MILD STEEL
(For L-Clamps, adjusting plate, paddles)
1. Possess good ductility and can be bent easily.
2. Possess good machinability.
3. Has good tensile strength.
4. Possess excellent weld ability.
5. Good toughness and hardness.

8. PROPERTIES OF TEMPERED STEEL
(Used for supporting rods)
1. Very high tensile strength.
2. Excellent toughness and hardness.
3. Ductility is reduced.
4. Machinability is reduced.

9. PADDLES
The rotating type paddles is used to give displacement in water. It’s made of sheet metal of 1 mm thickness. The paddles are nothing but blades that rotate by peddling action. The paddle blades are welded to a hollow pipe which is welded to a hub. The hub is welded with the sprocket and chain drive connects the paddle sprocket with the rear double threaded hub sprocket. Thus the paddles rotate by the chain drive power transmission. There are 6 blades in total which acts as two paddles in the versatile bicycle.
10. EXPERIMENTAL DETAILS

Average speed in water : 4 to 5 km/hr
Average speed on land : 15 to 20 km/hr
Time for fitting the Thermocol blocks : 2 to 3 mins
Time for dismantling the thermocol blocks : 1 to 2 mins

11. BUOYANCY FORCE

Buoyancy is an upward force exerted by a fluid that opposes the weight of an immersed object. In a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. Thus a column of fluid, or an object submerged in the fluid, experiences greater pressure at the bottom of the column than at the top. This difference in pressure results in a net force that tends to accelerate an object upwards. The magnitude of that force is proportional to the difference in the pressure between the top and the bottom of the column, and is also equivalent to the weight of the fluid that would otherwise occupy the column, i.e. the displaced fluid. For this reason, an object whose density is greater than that of the fluid in which it is submerged tends to sink. If the object is either less dense than the liquid or is shaped appropriately (as in a boat), the force can keep the object afloat. This can occur only in a reference frame which either has a gravitational field or is accelerating due to a force other than gravity defining a “downward” direction. In a situation of fluid statics, the net upward buoyancy force is equal to the magnitude of the weight of fluid displaced by the body.

12. PROPERTIES OF EXPANDED POLYSTYRENE (THERMOCOL)

Typical Properties:

- Density Range: 15-30 Kg/m³
- Thermal conductivity at 10 mean temperature: 0.028-0.031 K cal m/hr. m c
- Compressive Strength: 0.8-1.6 Kg/cm
- Cross breaking Strength: 1.4-2.0 Kg/cm
- Tensile Strength: 3-6 kg/cm
- Application Range: -200 +80 deg C
- Water absorption by % Volume for 7 days in water: 0.5%
- Self ignition point: 300 C
- Melting Range: 100-200C

13. WORKING OF VERSATILE BICYCLE

In versatile bicycle, thermocol blocks are used to create buoyancy force. There are 4 blocks of even volume to give balance in the water. The thermocols are attachable and detachable in the L-clamps and the L-clamps itself is foldable. The movement in the water is given through rotating paddles that are fixed at the back of the versatile bicycle. These paddles are connected to the rear wheel of the bicycle through chain drive. Double threaded hub has been used to
put on two sprockets. In one sprocket, the normal chain is connected to the pedals and in another sprocket, the chain drive that rotate the paddles are connected. Thus, the movement is given. These paddles can be adjusted according to the weight of the rider when inside the water. There is an adjustable rod that increases or decreases the altitude of the position of the paddles. The paddles should be half inside and half outside the water to maximum displacement.

14. ADVANTAGES OF VERSATILE BICYCLE

• Single vehicle is used instead of two vehicles while crossing water bodies.
• Reasonable speed on water is achieved.
• No major unease or discomfort to rider while riding on land.
• The thermocol blocks are detachable, hence weight is reduced while riding on land.
• There is no sucking of water by thermocol as its of high density quality.
• In overall, the vehicle is very robust and can be used in any conditions.
• As the vehicle is cycle, its pollution free and environmental friendly.
• No extra fuel or energy required.
• As the factor of safety given is 2, the chances of drowning is zero.

15. DESIGN CALCULATIONS

Density of water = 1 g/cm³
Density of thermocol = 20 kg/m³ => 0.02 g/cm³

Density of thermocol > density of water
Thus thermocol floats in water.

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>25 kg</td>
</tr>
<tr>
<td>Rider</td>
<td>75 kgs</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100 kgs (app. mass)</td>
</tr>
</tbody>
</table>

Applied load = 100 x 9.8 Newtons = 980 Newtons

Required factor of safety is 2.

Factor of safety = allowable load/applied load

2 = allowable load / (100 x 9.8)

Allowable load = 2 x 100 x 9.8 Newton
Allowable mass = 200 kg or 200000 grams

1 cm³ of thermocol can bear (1 - 0.02) grams of mass.

= 0.98 grams of mass

So for bearing 200000 grams of mass, we need 200000/0.98 cm³ of thermocol.

= 204081 cm³ of thermocol required.

No. of blocks needed = 4

So, volume of 1 block = 204081/4 = 51020 cm³.

Standard thickness of thermocol blocks = 20 cm

Volume of 1 thermocol block = surface area x thickness

51020 = required surface area x 20

Required surface area = 51020/20 = 2551 cm².

The thermocol blocks are cut in aerodynamic shape as per design requirement shown (surface area > 2551 cm²) in fig

Final dimensions of the thermocol block

![Dimensions of Thermocol Block (Fig. 9)](image)

The above dimensions are chosen to get the required surface area, thus to satisfy the design.

Surface area = [(50 x 36)+(0.5 x (12+50) x 25)]

= 2575 cm² (> 2551 cm²)

Volume of 1 block = 2575 x 20
Thus the design of thermocol blocks are satisfied.

16.1. TEST DRIVE IN WATER

16.2. TEST DRIVE ON LAND

17. APPLICATIONS OF VERSATILE BICYCLE

- Used to cross rivers, ponds, lakes in villages.
- Can be used as main mode of transport in states like Kerala, Goa etc. where crossing of back waters is very much necessary task.
- Can be used in flood prone states like Bihar, West Bengal, Orissa etc. as a medium of transport for evacuation process.
- Can be used as a medium of transport in areas like Velachery, Madipakkam, Adambakkam, Korattur, Annanur etc. where short term flooding occurs during monsoon season.
- Can be used as a water sport in tourist spots like Ooty, Kodaikanal etc. along with boating.
- Can be used for small scale fishing process in lakes and ponds.
- Can be used by children for having fun in water ride and also serves as normal bicycle.

18. LIMITATIONS OF VERSATILE BICYCLE

- Though the versatile bicycle reaches a reasonable speed in water, its lower than hi-tech amphibious vehicles that runs on fuel.
- The stylish shape of the bicycle is slightly altered.
- Doubles cannot be ridden in versatile bicycle as the clamps are fixed.

19. COST OF FABRICATION

<table>
<thead>
<tr>
<th>S.NO</th>
<th>COMPONENTS</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BICYCLE (used)</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>THERMOOL</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>M.S.SHEET</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>MISCELLENEOUS (HUBS,SPROCKETS,CHAINS ETC)</td>
<td>1000</td>
</tr>
<tr>
<td>5</td>
<td>FABRICATION (LABOR,TRANSPORTATIONS ETC)</td>
<td>2000</td>
</tr>
<tr>
<td>6</td>
<td>TOTAL</td>
<td>7000</td>
</tr>
</tbody>
</table>

20. COMMERCIALIZATION OF OUR PRODUCT

Our product has not yet hit the market so far. So it will be a brand new innovation. It has a great potential market in states like Kerala, Goa where crossing of back water is a unavoidable task and in flood prone states like Bihar, Orissa, West Bengal, Tamil Nadu etc. Once it launches in market, our product will become a basic need in each and every house. As our product has a lot of major applications, it has a great potential to be commercialized in the market successfully. And more over the usage of bicycle is getting very low as the exposure to motor bikes is very high among children in India. Children are losing interest in bicycle and the bicycle manufacturers ought to do something innovative to keep the
bicycle alive for at least next few decades. So our innovation will help in attracting the young people towards using bicycle and boost up the bicycle market by introducing an extra wow factor in the normal bicycle.

21. FUTURE DEVELOPMENTS IN VERSATILE BICYCLE

- To replace the thermocol material with inflatables filled with air of that shape.
- Making the whole L-clamp easily detachable and attachable.
- To replace the paddles with propellers for giving high displacement in water.
- To improve the aesthetics of the bicycle to make it more marketable.
- To use aluminum hollow pipes instead of mild steel to decrease the weight.
- To increase the velocity of the bicycle in water.
- To improve the aesthetics and ergonomics of the versatile bicycle.
- To make the whole water mode attachments like L-Clamps, thermocols, paddles attachable and detachable in any standard bicycle.

22. CONCLUSION

An amphibious vehicle ‘versatile bicycle’ is designed and fabricated successfully. It is tested in land as well as on water and the velocity is calculated as 4-5 km/hr in water and 15-20 km/hr on land.

23. REFERENCES

1. Fluid Mechanics by R.K. Purohit
2. Fluid Mechanics By Victor Streeter, Benjamin Wylie and K.W. Bedford
3. Introduction to Polymer Chemistry by Charles E. Carraher, Jr.
4. An Introduction to fluid dynamics by Batchelor
5. An Introduction to Computational Fluid Dynamics: The Finite Volume Method (English) 2nd Edition by Versteeg.