Design and Fabrication of Bubble Barrier with Conveyor

[1]SUPRITH M, [1]SURAJ LAKSHMANSINGH, [1]SWARAJ S BELAMAGI, [1]YOGESH BIRADAR, [2]ARUN KUMAR H
School of Mechanical Engineering,
REVA UNIVERSITY

Abstract—.This project emphasis on design and fabrication of the “bubble barrier system” a machine, which involves the removing of waste debris from water, and safely dispose it from the water body. The work was done looking at the current situation of our national rivers, which are dumped by sewage, pollutants, toxic materials, debris etc Bubble barrier generate distinct acoustic and hydrodynamic fields, and through proper manipulation, juvenile carp migration can be prevented. A conveyor will lift the waste surface debris from the water bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. The main aim of the project is to reduce the man power, time consumption for cleaning the river. In this project we use bubble barrier to clean the flowing water body with help of conveyor we lift the waste from water body

Key words— bubble barrier system, debris, conveyor, water body, etc

1 Introduction

Water is a basic necessity of humans and all living beings. There is a plenty of water on earth but that is not suitable for human use. Clean water is more important and is used for some purpose. The impurities present in water can cause hazardous diseases.

The Drainage water cleaner system are used to clean wastes from water like polythene,bottles etc. present in water .This can be used to overcome the problem of filtration of wastes from water and it save the time and cost that spend on cleaning the drainage. As the industry setup increase in the environment the water coming from industries are full of wastes like polythene, bottles, and other materials and that water mix with the other water that are used by people and we know that that water is not good for the for health of people. So to overcome from these problems we can filter the water drainage water before it mix with other water. This type of filtration of water is called primary filtration. In this project we use DC or AC motor to run the system when power supply is available& the Equipment we used are motor, chain, driver, bucket, frame, wheel, sprocket gear, solid shaft etc.

we block plastics from moving downstream and make clever use of the current of the river to direct the waste to the banks. We create a bubble barrier by pumping air through a tube with holes, placed on the bottom of the river.

We found an elegant solution that blocks waste in the river, but also allows the passage of fish a barrier of bubbles. By placing two bubble barriers diagonally in the waterway.The upward current that the bubbles generate brings the waste to the surface, and the turbulence stops the waste from flowing downstream The waste gathers on the side of the river, where it can easily be collected with for example a conveyor belt

2 Objectives

1. To design and develop Bubble Barrier Conveyor to clean up the plastic soup in water bodies and remove macro plastic form water bodies by conveyor system.
2. Measure and monitor the amount of plastic in the water bodies to help develop better policy and action.
3. To develop the prototype of bubble barrier to conduct experiments
4. Increase the oxygen quantity in water bodies
5. To measure the performance of Bubble Barrier in different water bodies with different bubble size.

3 Methodology and working

Methodology used for whole processing of Machine is given below; this methodology gives way about how work is to be carried out in systematic way. It is standard process of describing process, how it is done in simplest mannerin IJSER Transactions are edited electronically.

3.1 Working

The bubble barrier is created by pumping air through a tube with holes which is placed at the bottom of the river. With the help of a compressor device which is located on the bank of the river the compressed air is pumped through tube. The rising bubbles create a barrier of bubbles as these bubbles move up it results in an upwards current which brings the waste to the surface. In order to stop the waste at the surface to flow downstream the tube is placed diagonally on the bottom of river and make clever use of the current of the river to direct the waste to the banks (Figure a). By using this we can remove out the submerged and floating plastic and paper waste from flowing water bodies. By varying the pressure of air flowing through tube, size of the tube and size of the holes we can use this in kinds of water bodies of different depth, flow rate and width. The waste accumulates on the side of the river where it can easily be collected with a catchment system like conveyor system. . Fish can pass through the bubbles, underneath the bubble tubing or through the fish pass. Besides the capture of debris, the Bubble Barrier has other positive side effects.

Oxygen levels within the water increase by a Bubble Barrier, which stimulates the ecosystem and stops the growth of toxic blue algae .As bubble screens absorb sounds and waves, fish and shores experience less harm from the ship traffic. By using conveyor waste is screened and carried out of the water body using the mesh buckets to the waste collecting pit. ¼ of the conveyor is submerged in the water where waste is accumulated so that the complete waste is removed out. The conveyor is chain driven and a DC motor is used to d

rive the conveyor. This motor is made to operate automatically according to the conditions like flow rate and density of waste in river. Automation is done using an electronic system which is fade with programing.

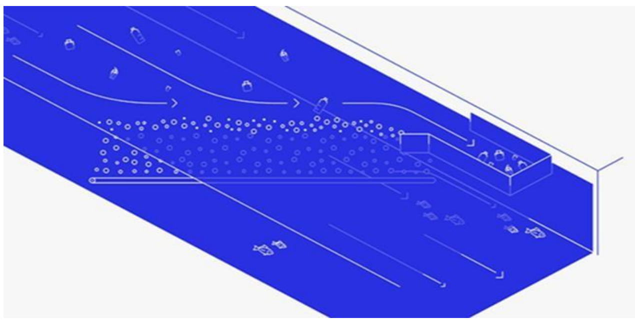


Figure 3.1. Schematic top view of the river, where the Bubble Barrier blocks waste by smart use of the current

3.2 AUTOMATION

Working:- bubble barrier depend on flow of water it works with more efficient in certain flow of water for that taking that as variable if the water flow increase the speed of conveyor should increase and amount of air flow rate should increase .and if the water flow rate is decrease the speed of conveyor should decrease and air flow rate decrease and after the certain water flow rate limit above and below the whole system should shut down

Details :- for this automation arduino is used and for water flow rate water sensor is used and for display of water flow rate and status (efficiency) of system led screen and motor for conveyor and dc power supply all are inter connected to arduino for complete automated.

3.3 Bubble Physical Characteristics

Understanding the formation of a single bubble through an orifice is vital to developing diffusers that can create well defined and predictable physical fields. Bubble formation is driven by two main components, buoyancy and surface tension. The buoyancy force acts to drive the bubble towards the surface, while the surface tension acts to keep the bubble attached around the orifice. As the bubble size increases, the buoyancy force overcomes the surface tension and the bubble detaches from the surface. Bubble formation creates pressure waves (sound) throughout the liquid and accounts for most of the sound generated by a bubble curtain. As the bubbles rise, they coalesce (merge to form larger bubbles). The thickness of the bubble curtain also increases as the bubbles rise. These characteristics were utilized to design two diffuser types; finebubble and coarse-bubble.

When a bubble is disturbed by a pressure wave, it causes the bubble wall to pulsate or oscillate at a resonant frequency. Theoretical relationships have been developed to predict the resonant frequency and amplitude of the pressure wave created by an oscillating bubble. Understanding the small scale characteristics of bubbles may provide insight to interpreting the sound signal generated by a bubble barrier, and potentially improve the barrier design. The resonant angular frequency, natural frequency of bubble wall oscillations, of a singular bubble is provided by Minneart's frequency

4. Calculation

1) Determine the velocity ratio of the chain drive

Velocity ratio = N1/N2

So, N1/N2 = T2/T1, velocity ratio = 1

2) Select the minimum number of teeth on the smallest sprocket or pinion

Minimum Number of Teeth on the Sprocket = 18

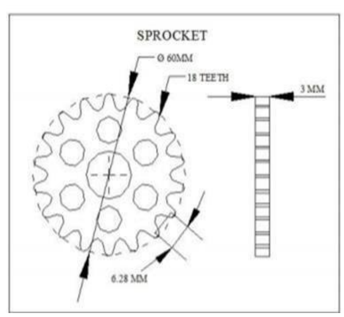
3) Determine the design power by using the service factor, such that

Design power = Rated power x Service factor (Ks)

= 106.25 x Service factor (Ks) = 106.25 x (Load factor (K1) x (Lubrication factor (K2) X rating factor (K3)

= 106.25 x (1.5 x 1 x 1.25)

Design power = 0.20kW



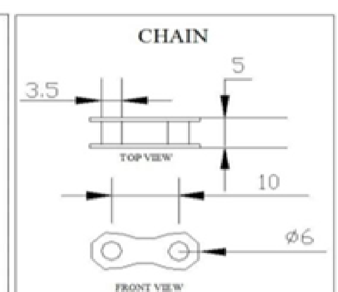


Figure 3.1.sprocket Figure 3.2.chain

4.1Motor calculation:

Type: - DC Motor

Power= V×I

Where, Volt= 12V
Amp=7.6 amp
Power= 12×7.6
Power= 85 watt

4.2 Design of spur gear
Design power
Pd=PR×Ki
Where Ki=1.25 for light shocks (8 to 10 hrs a day)
Pd=85×1.25
Pd=106.25 watt

4.3Total load:
Total load Ft=Pd÷Vp
Where,
Ft= tooth load
Vp= pitch line velocity

4.4 Angular velocity
Vp= (πDpN)/ (60*1000)
Vp= (πDpN)/ 60
Where,
Dp=m×tp tp= pinion teeth=24
Vp= (π× m×24×30)/ 60 Vp=0.03769 m

4.5 Tangential force Ft=Pd ÷Vp
Ft=106.75÷0.03769m
Ft=2832/m

4.6 Bending strength by Lewis equation, FB= So×Cv×b×y×m
Where So=Basic strength Mpa
So=245Mpa SAE 1045 heat treated Cv=0.4(assume) b=Face width= 10m Modified Lewis factor 20o full depth
Yp=0.485-(2.87/tp) for pinion
Yp= 0.3667
Yg=0.485-(2.87/tg) for gear
Yg= 0.42583
FB= So×Cv×b×y×m
FB= 245×0.4×10×m×0.3667×m
FB= 359.36m2

Using criteria,
Ft= FB
2832.31/m=359.36m2 m=1.99 mm
m=2 mm design book table
Dp=48mm
Dg=96mm
FB=So×Cv×b×y×m b=1993.75/245×0.4×0.3255×2 b= 20mm b=10*m=20

Now, checking face width
Ft= FB
Ft= 2832.31/m= 1416.15N
Ft= 1416.15N
FB=359.36m2
FB=1438.75N
Ft< FB
Design is safe

4.7Dynamic load:
Fd= Ft+(21Vp(Ceb+Ft)/ 21Vp+√Ceb+Ft)
Vp=0.02827*m
Vp=0.075m/sec
Where,
C=Deformation Factor table XVI-4 C=11800-(20o full depth) b=1
e= error in profile= 0.05
Fd=1416.15+(21×0.075(11800×0.05×20+1416)×21*.075+ √11800×0.05×20+1416)
Fd=1595 N
Fd>Ft

4.8Limiting wear strength
Fw=Dp×b×k×Q Q = 2tg/tg+tp
= 2×48/48+24
Q =1.33
Fw =48*20*k*1.33
Fw=1276K

Using Criteria,
Fd=Fw
1594=1276K
K=1.24
BHN core=350 For pinion 20o full depth involute profile
Fw=1276×1.24
Fw=1582 N
Fd>Fw

4.9Endurance strength
Fen =Seb×b×Yp×m
Where Seb= 596mpa Yp=0.3667 b=20 m=2
Fen =596×20×0.3667×2
Fen= 8742 N Fen> Fd Hence design is safe.
5.1.10Gear ratio:
N1/N2=T2/T1
Where,
N1=rpm of pinion
N2 = rpm of gear
T2=teeth of gear
T1 = teeth of pinion
30/N2=48/24 N2=15RPM
Power= 2πNT/60
Torque T=1416×0.048=67.96 N
Power =2×3.14×15×67.96/60

Power= 106.75Watts

Hence Design is safe

Density of the water, $\rho = 1000\ kgm^{-3}$

The Acceleration of gravity, $g = 9.81\ ms^{-2}$

Water pressure $P_1 = P_a + P_h$

Where,

P_a = atmospheric pressure

P_h = hydrostatic pressure

($P_h = \rho g h$)

Pressure at surface is equal to atmospheric pressure

$P_2 = P_a$

$P_1 V_1 = P_2 V_2$

$(P_a + h\rho g) \times 4/3 \pi r_1^3 = P_a \times 4/3 \pi r_2^3$ $r_2 = (((P_a + h\rho g)(r_1)^3)/P_a)$

Bubble Radius at surface of water is r_2 r_2 = 7mm

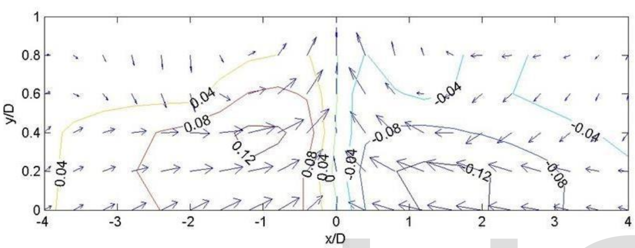


Figure 4.1. Velocity field for coarse-bubble diffuser at 2.5 Ls-1m-1

Table 4.1.Compare b/w fine bubble and coarse bubble

Diffuser Type	Flow-rate (Ls-1m-1)	Depth (cm)	Maximum Velocity (cm/s)	Stagnation Point Location (X,Y)
Fine-Bubble	1	25	8	(+/-1,0.6)
	2.5	25	16	(+/-1,0.75)
	2.8	25	17	(+/-0.8,0.6)
	2.5	50	13	(+/-1.5,0.75)
	2.8	50	16	(+/-2,0.75)
Coarse-Bubble	2.5	25	12	(+/-1,>0.8)
	2.8	25	13	(+/-1.5,>0.8)

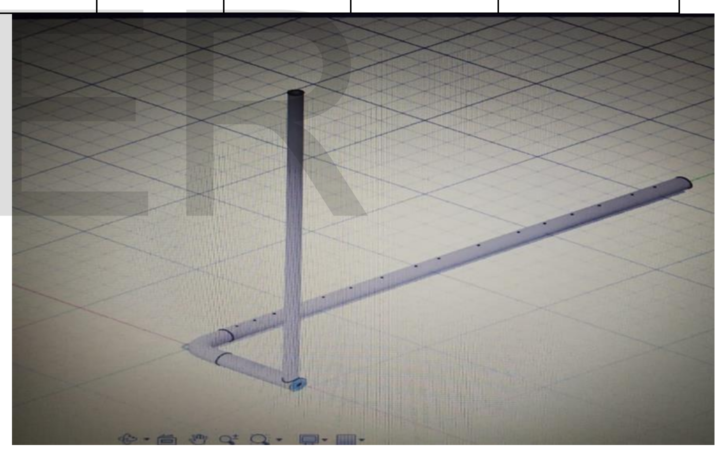
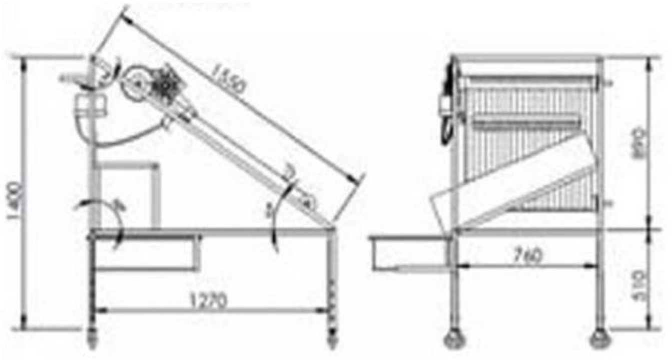


Figure 5.1.design of diffuser

.

5. Design and Analysis



FRONT VIEW SIDE VIEW

Parameters (conveyor)	specifications
1. Height (with stand)	1400mm
2. length	1200mm
3. Width	700mm
4.Inclined length	1040mm
5. Inclined angle	36 degree
6. Height (without stand)	890mm

Parameters(bubble barrier)	specifications
Length	2500mm
Height	600mm
Width	500mm
Pipe diameter	35mm
Hole diameter	Varies depends requirement bubbles
Air compressor(pressure)	300psi

6. RESULTS AND DISCUSSIONS

The Bubble Barrier will reduce the amount of plastic pollution in rivers and can help raising awareness in order to prevent further plastic pollution and it can be placed in various rivers and canals.

1. It catches more plastic than current solutions in flowing water because we can reach plastic (> 1mm) in the total width and depth of a river. A Bubble Barrier can be placed both in rivers as in small canals.

2. By the theoretical analysis and calculation we can get more efficiency with varying the size of the hole diameter.

3. The waste debris which are collected in bubble barrier that will be simultaneously dumped out of the canal by automatic operated conveyor. And speed of the conveyor belt is regulated with respect to the diffuser variation

7. CONCLUSION

Hence we can conclude that the main objective of this project "design and fabrication of bubble barrier with conveyor" is used for various purposes like,

1. The rising bubbles result in an upward current, which brings plastic waste to the surface. Water flow directs it to the side of the water body stopping it from flowing further downstream
2. We can measure and monitor the amount of plastic in the water bodies by varying with help of diffuser.

Acknowledgments

The satisfaction and excitement that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose consistent guidance and encouragement crowned our efforts with success.

We consider ourselves proud to be a part of REVA University family, the institution which stood by our way in all our endeavours. We express our sincere thanks to Dr. K S Narayanaswamy Director and Professor, School of Mechanical Engineering, for his support and encouragement.We express profound thanks to Prof.Arun Kumar H, Assistant Professor, School of Mechanical Engineering, for his valuable support & for his inspiration, guidance, constant supervision, direction and discussions in successful completion of this project.

We are thankful to the project coordinators, teaching and nonteaching staff members of School of Mechanical Engineering for their co-operation extended towards this work.

Finally, we express ourselves heartfelt gratitude to our parents, members of our family and our friends, for their constant support, motivation and encouragement throughout this project. Above all we would like to thank God, Almighty, for having showered his blessings on us.

REFERENCES

[1] Akamatsu, T.,Okumura, T.,Novarini, N., Yan, H.Y., 2002. Empirical refinements applicable to the recording of fish sounds in small tanks. J. Acoust. Soc. Am. 112 3073– 3082.

[2] Bainbridge, R., 1964. The problem of excluding fish from water intakes. Ann. Appl. Biol. 53, 508–515. Bajer, P., Sorensen, P., 2010. Recruitment and abundance of an invasive fish, the common carp, is driven by its propensity to invade and reproduce in basins that experience winter-time hypoxia in interconnected lakes. Biol. Inv. 12,1101– 1112.

[3] Brett, J.R., MacKinnon, D., 1953. Preliminary experiments using lights and bubbles to deflect migrating young spring salmon. J. Fish. Res. Board Can. 10, 548–559.

[4] Brevik, I., Kristiansen, Ø. 2002. The flow in and around air-bubble plumes. Int. J.Multiph. Flow 28, 617–634.

[5] S S Rattan Department of Mechanical Engineering Regional Engineering College Kurukshetra (2004). "Theory of machines" Publication: Tata McGraw-Hill Publishing Company Limited.

[6] Karichappan, Thirugnanasambandham, Venkatachalam Sivakumar and Lenganathan Prakash Maran, Optimization of electrocoagula-
tion A process to treat grey wastewater in batch mode using response surface methodology, Journal of Environmental Health Science and Engineering, 2014, Vol. 6, Issue 3, Pp.2213-2243.

[7] V Vivek. Jawnekar, Mr. Dhiraj, C Jagtap, Shubham, Gulhane H., Arti Jamdapure and Duryodhan N S, Pedal Operated Bicycle Drain Cleaner,International Research Journal of Engineering and Technology (IRJET), Vol. 4, Issue 6, Pp. 23-43.

[8] Ganesh U L, Vinod V Rampur, Semi-Automatic Drain for Sewage Water Treatment of

[9] Floating Materials, IJRET: International Journal of Research in Engineering and Technology, Issue 10, Vol. 4, Pp.2319-1163 [10] “Bubbles , Drops and particles” R. Cliff , J.R. Grace and M.E. Webr “Ellipsoidal model of the rise of a Taylor bubble in a round tube” T. Funada , D.D. Joseph b,*, T. Maehara , S. Yamashita

[11] http://www.madsci.org/posts/archives/1997-08/865365227.Ph.r.html

[12] [Ganesh U L,et.al.“Semi-Automatic Drain For Sewage Water Treatment Of Floating Materials”, International Journal of Research in Engineering and Technology, Vol No- 05, Jul-2016.

[13] James C. Conwell, G.E. Jhonson, “Design, Construction and Instrumentation of a Machine to Measured Tension and Impact Forces in Roller Chain Drives”, December 1989.

[14] S D Rahul Bharadwaj, Shraddha R Jogdhankar, “Automatic Wastewater treatment process to reduce global warming” International Journal of Environmental Science: Development and Monitoring, Vol No- 2 (2013).

[15] Dr .K.Kumaresan et.al. “Automatic Sewage Cleaning Equipment”, International Conference on Explorations and Innovations in Engineering and Technology, 2016.

[16] R.Sathiyakala et.al. “Smart Sewage Cleaning System” International Journal of Innovative Research in Computer and Communication Engineering, Vol No- 4, February 2016.

[17] Balachandra, et.al.”Automatic Drainage Water Pump Monitoring and Control System Using PLC and SCADA” International Journal of Innovative Research in Technology, Vol No- 1, 2014.

[18] Nitin Sall, et.al. “Drain Waste Water Cleaner”, Global Journal of Researches in Engineering: J General Engineering Vol No- 16, 2016.

[19] NDUBUISI C. Daniels, “Drainage System Cleaner A Solution to Environmental Hazards”, International Refered Journal of Engineering March 2014.

[20] Theory of machines –S S Rattan Department of Mechanical Engineering Regional Engineering College KurukshetraS (2004). Publication: Tata McGraw-Hill Publishing Company Limited.

[21] Akamatsu, T., T. Okumura, N. Novarini, and H. Y. Yan. 2002. Empirical refinements applicable to the recording of fish sounds in small tanks. The Journal of the Acoustical Society of America 112 (6) (Dec): 3073-82.

[22] Dawson, H. A., U. G. Reinhardt, and J. F. Savino. 2006. Use of electric or bubble barrier to limit the movement of eurasion ruffe (gymnocephalus cernuus). J. Great Lakes Res. (32): 40-49.

[23] EPRI. 1998. Evaluation of fish behavioural barriers. Palo Alto CA: TR-109483. Fannelop, T. K., S. Hirschberg, and J. Küffer. 1991. Surface current and recirculating cells generated by bubble curtains and jets. Journal of Fluid Mechanics 229 (1): 62957.