RESEARCH ARTICLE OPEN ACCESS

Water Hyacinth Shredder

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Abstract:

In many countries throughout the world struggling with massive amounts of water hyacinths affects in the country's fresh water recourses and created problems associated with navigation, national security, irrigation and drainage, water supply, hydro electricity and fishing. Mechanical removal is most effective Method for Aquatic plant removal. In this project we are designed and manufactured water hyacinth shredder prototype in which we designed shaft, conveyor, bearing, & cutters, and making frame and selection of motor.

Keywords — **Water hyacinth, mechanical removal, Aquatic plant, Water resources.**

I. INTRODUCTION

Water hyacinth is a floating water weed with a fibrous root system and dark green rounded leaves up 3 to 5 cm in diameter. The leaf stalks are swollen into spongy, bulbous structures. Water hyacinthis the most predominant, persistent and troublesome aquatic within the world and has posed ecological and economical problems in several countries. Many studies have been conducted to evaluate utilization of water hyacinth and removal of water hyacinth vegetation. The major problems of water hyacinth its affect the countries fresh water recourses. Water hyacinth is considered a serious and one of the most noxious aquatic pests in many parts of the world. Its rapid growth has clogged major waterways and created problems associated with navigation, national security, irrigation and drainage, water supply, hydro electricity and fishing in many countries Because Of its devastating effects on aquatic ecology and 'man,

It's called "green devil" or "Bengal tenor" in India, "Florida devil" in America. The weed promotes greater evapotranspiration through its many leaves thus accelerating the drying up of rivers, lakes, reservoirs, canals, river basins, etc. It also promotes considerable ecological succession, creating islets and sandbars.

Fig.1Mula-Mutha River covered by water hyacinth

In pune municipal corporation spend around 27 lakes rupees in 2012-2013 budget.. the pashan lake and some places in mula –mutha river are blocked by water hyacinth but there are no effective technique both pune and pimpri chichwad municipal corporation these authority just giving contract to few contractors and this contractors have some labors they remove this vegetation manually it's so risky. In last 5 years around more than 2 core money waste both pune and pimpri Chinchwad Corporation to remove this water hyacinth therefore its alarming needs to find perfect solution.

The spread of water hyacinth in the country is perceived as a major environmental problem (World Bank 1990). This is especially so in the South where many rivers and channels are blocked by denser growths of the weed which impede navigation, block access of artisanal fishermen to fishing

grounds and the spread of water hyacinth affects the water quality. There are some methods to remove or control water hyacinth from lake or cannels like chemical control method and biological control method but these methods are less efficient compared to mechanical removal method also chemical and biological method affects the water quality, human, and wildlife. Therefore we decided to make a small prototype of Mechanical water hyacinth removal is most effective method to remove the water hyacinth vegetation. Mechanical water hyacinth control method may be applied to emergent, floating, and submersed aquatic vegetation. A mechanical aquatic shredder (harvester) is a type of small vegetation cutting machine used for a variety of tasks, including aquatic plant cutting, and this small pieces collecting and trash removal in rivers, lakes, bays, and harbors. Harvesters are designed to cut, collect and unload vegetation and debris using a cutters, guide, and conveyor system on ship, its small prototype so it has adjustable to the small appropriate cutting height, up to 0.5 feet below the surface of the water. Cutter bars(guide) cut, and collect material and bring it aboard the vessel using the conveyor; when the conveyor has reached capacity, cut material is transported to a disposal site(ship) although the conveyor continuously operate so no matter quantity of the vegetation it can transfer also small amount of vegetation and offloaded using the conveyor. shredder barges(guide) are typically driven by a 12 volt Direct current motor which has 500 rpm, motor provide powers to a cutter bars and the conveyor system . Mechanical harvesting provides good control of floating vegetation, but the effort will not result in eradication of a plant small species. The size and nature of the equipment does not allow targeting individual plants or small infestations.

Narasinmha Ramula K and Benargee G [1] they provided new baseline information on the diversity, distribution and interspecific associations of floating-leafed and submersed aquatic plants in Nagaram tank that will be useful for managing and or controlling the plant species.

Brezny et al. [2] reported evapotranspiration for water hyacinth was 130 to 150% higher than evaporation from a free water surface under equivalent conditions.

Abbasi [3] worked on renewable energy from aquatic biomass.

Muragesan and Sukumaran [4] gave sustained management of nuisance weeds of freshwater habitats by the utilization as viable resource for mutivarious application.

Meera et al. [5] worked on aquatic weeds as resource of multiple utility.

Sharda.A.Nikam (Deshmukh) [6] she conducted several site visits to check the extent of pollution of the river water at different locations.

a) PROBLEM STATEMENT

i. Destruction of biodiversity

Today, biological alien invasions are a major driver of biodiversity loss worldwide. Water hyacinth is challenging the ecological stability of freshwater water bodies, out-competing all other species growing in the vicinity, posing a threat to aquatic biodiversity.

ii. Oxygen depletion and reduced water quality

Large water hyacinth mats prevent the transfer of oxygen from the air to the water surface, or decrease oxygen production by other plants and algae. When the plant dies and sinks to the bottom the decomposing biomass depletes oxygen content in the water body. Dissolved oxygen levels can reach dangerously low concentrations for fish that are sensitive to such changes. Death and decay of water hyacinth vegetation in large masses deteriorates water quality and the quantity of potable water, and increases treatment costs for drinking water.

iii. Breeding ground for pests and vectors

Floating mats of water hyacinth support organisms that are detrimental to human health. The ability of its mass of fibrous, free-floating roots and semi-submerged leaves and stems to decrease water currents increases breeding habitat for the malaria causing anopheles mosquito as evidenced in Lake.

Iv. Blockage of waterways hampering agriculture, fisheries, recreation and hydropower

Water hyacinth often clogs waterways due to its rapid reproduction and propagation rate. The dense mats disrupt socioeconomic and subsistence activities (ship and boat navigation, restricted access to water for recreation, fisheries, and tourism).

II. CONSTRUCTION:

a. Motor

The motor is single phase 12 volt DC motors, meaning that the speed is infinitely variable from 0-300 rpm. The motor is mounted on the machine frame and is connected to guider shaft and also linear blades through connecting links.

b. Linear blades

Linear blades are made up of mild steel material (M.S.). We used 6 linear blades, which is fixed on machine frame in which one blade is fixed on machine frame and other blade is slide on fixed blade. Rotary motion of motor is converted into reciprocating motion of blades by connecting link.

c. Conveyor belt

Conveyor belt is made up of rubber. This is moving on driven and driver pulleys by motors

d. Drive and Driven pulley

Drive and driven pulleys made up of nylon material which has properties like light in weight, sufficient strength etc. on which conveyor belt is moving due to motor.

e. Rotary Guider

It is made up of plastic like Teflon on which steel blades are inserted and fixed by amsiles.

f. Bearing

We select ball bearing on which radial load is act. The shaft and drive and driven pulleys are held in ball bearing mounted in bearing housing and rotates freely in it.

g. Boat

Boat is made up of galvanized iron sheet. The main function of boat is to carry entire assembly in water and store the water hyacinth in boat hub.

h. Frame

It is made up of mild steel material (M.S.). The entire assembly is mounted on frame which is linear blades, rotary guider, bearings, conveyor, and motors.

III. WORKING:

Fig.2 Working of Water Hyacinth Shredder

A mechanical water hyacinth shredder a type of small vegetation cutting machine used for a variety of tasks, including aquatic plant cutting, and this small pieces collecting and trash removal in rivers, lakes, bays, and harbors. Harvesters are designed to cut, collect and unload vegetation and debris using a cutters, guide, and conveyor system on ship, its small prototype so it has adjustable to the small appropriate cutting height, up to 0.5 feet below the surface of the water. Cutter bars(guide) cut, and collect material and bring it aboard the vessel using the conveyor; when the conveyor has reached capacity, cut material is transported to a disposal site(ship) although the conveyor continuously operate so no matter quantity of the vegetation it can transfer also small amount of vegetation and offloaded using the conveyor. shredder barges(guide) are typically driven by a 12 volt Direct current motor which has 500 rpm, motor provide powers to a cutter bars and the conveyor system . Mechanical Shredding provides good control of floating vegetation.

IV. MECHANICAL DESIGN:

a. Design of guider shaft:-

MATERIAL SELECTION:-

MATERIAL	ULTIMATE TENSILE STRENTH N/mm2	YIELD STRENTH N/mm2
TEFLONE	40	25

1.1 ASME CODE FOR DESIGN OF SHAFT

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of loads fluctuations. According to ASME code permissible values of shear stress may be calculated from various relations.

Fs max = 0.18 Sut
= 0.18 x 40
= 7.2 N/mm2
Or
Fs max = 0.30 Syt
= 0.30 x 25
= 7.5 N/mm2

Considering the minimum of the minimum of the above values,

Fs max = 7.2 N/mm2

This is the allowable values of shear stress that can be inducted in the shaft material for safe operation.

1.1.1 TO CALCULATE SHAFT TORQUE

POWER = 2∏NT/60

Motor is 9.6 watt power, run at 300 rpm, connected to shaft

Hence,

T = (60 x P) / (2 x ∏ x N)
= (60 x 9.6)/ (2 x ∏ x 100)
= 0.3055 N_m
Or
T_{design} = 0.3055 x 10^3 N_mm2

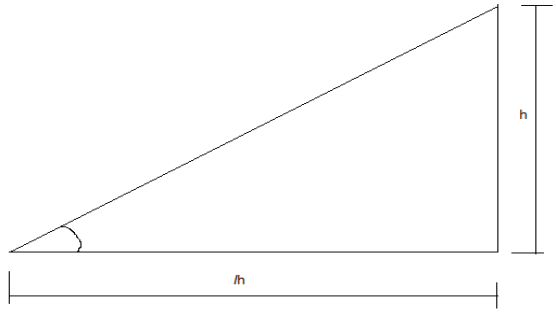
CHECK FOR TORSIONAL FAILLURE OF SHAFT

Diameter of shaft (d) = 15 mm
D_{dsign} = ∏/16 x Sact x d3
Sact = 16 x Ddesign / ∏ x 15^3
Sact = 0.461 N/mm2
As, Sac t< Sall (Smax)
Shaft is safe under torsional load.

b. Design of conveyor

2.2 Mass capacity of conveyor (M):-

Maximum suitable belt inclination (α),

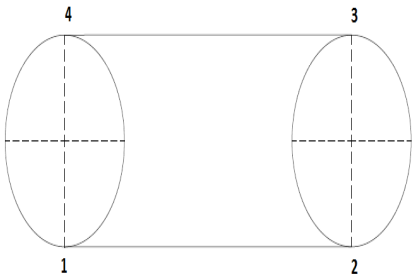


$\alpha = \tan^{-1}(h/l_h)$
$= \tan^{-1}(310/550)$
$= 30°$

BELT INCLINATION(A)	16 - 20°	21 - 25°	26 - 30°
FLOWABILITY (K) FACTOR	2.5×10^{-4}	2.35×10^{-4}	2.20×10^{-4}

From table, select 'K' value
$K = 2.20 \times 10^{-4}$
Mass capacity of conveyor (M),
$M = \rho Q$
$= \rho k (0.9B-0.05)^2 v$, kg/sec
Where,
ρ = density of water hyacinth kg/m^3
k = flowability factor = 2.20×10^{-4}
B = belt width = 310 mm = 0.31m
V = velocity of belt m/sec
Velocity of belt (v),
$V = \prod DN/60$
$= (\prod \times 0.021 \times 150) / 60$
$= 0.164$ m/s
$M = 670 \times (22.20 \times 10^{-4}) \times (0.9x0.31-0.05)^2 \times 0.164$
$= 1.2676 \times 10^{-3}$ kg/m^3
$= 4.5636$ kg/hr
$M_m = M/v$
$= (1.2676 \times 10^{-4})/0.164$
$= 7.7292 \times 10^{-3}$ kg

2.2.1 To calculate power requirement on drive pulley(P_0),



$F_i = F_{slack}$
$F_2 = F_i + F_{p1}$
$= F_i + \epsilon_{p1} F_{slack}$
$= F_{slack} (1+\epsilon_{p1})$
$= F_{slack} (1+0.06)$
$F_3 = F_2 + F_L$
$= F_2 + M$
$= F_{slack}\ 1.06 + M$
$F_3 = F_{slack}\ 1.06 + (1.2676 \times 10^{-3})$
$F_4 = F_3 + Fu$
$= F_{slack1.06} + (1.2676.x\ 10^{-3}) + m_m gH$
$= F_{slack1.06} + (1.2676 \times 10^{-3}) + (7.7279 \times 10^{-3}) x9.81 \times 310$
$= F_{slack} 1.06 + 23.5067$
$F_t = F_4 + F_{p2}$
$= F_4 + \epsilon_{p2} F_4$
$= F_4 (1 + \epsilon_{p2})$
$= F_{slack} 1.06 + 23.5067 \times (1 + 0.06)$
$F_t = F_{slack} 1.06 + 24.917$

Assume,
$\mu = 0.25$
$\Theta = (100 \times \prod)/180$
$= 1.7453$
$(F_{tight}/F_{slack}) = e^{\mu\theta} = e^{(0.25 \times 1.7453)} = 1.5470$
$1.06F_{slack} + 24.917 = 1.5470 \times F_{slack}$
$24.917 = 0.4870F_{slack}$
$F_{slack} = 51.164$ N
$F_{tight} = 79.151$ N
Power required on drive pulley (P_0),
$P_0 = (F_{tight} + F_{slack}) \times V$, W
$= (79.151 + 51.164) \times 0.164$
$= 4.7$ W
Power rating of standard electric motor selected is,
$P_0 = 9.6$W.

V. CONCLUSION

In this paper we concluded the mechanical water hyacinth shredder is most effective, efficient, economical compare to other method. One person can easy to operate from start to finish entire operation on machine. It is versatile to pulls, cut, and skims weeds in shallow water. It can be used as multipurpose to gathers floating debris and algae. It improves

the operational stability. It has 95% effective weed pulling. Due to mechanical shredding effective lake management are done. Therefore now it's the perfect time to making such machine and save our, lake, cannels, rivers.

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