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Optimization of Slime Coating Composition for Reduction of Bio – Fouling Agents in Vessels

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***Abstract*— Worlds major transportation done by water ways, but it also creates pollution over the time. So, in order to reduce the carbon footprint from our earth. We need to improve the efficiency, in water vessels efficiency is decreased due to adherence of fouling agents at the bottom of the ship. So we need create non adhering coating for bottom of ship. In the mean time we don't create harmful to marine organism. Because previous generation coating products comes with toxic based coating, over the time it will create harmful to the environment. But in project we created an eco-friendly coating with help of slime. We get inspiration from various marine organism like fish fin, crabs shell. Our coating is totally based on eco-friendly product. We made 8 samples based on the composition, from this sample we optimize perfect sample suitable for coating. Thereby with the replacement of conventional anti-fouling paints with our slime coating, it will be great contribution for nature by ourselves.**

***Index Terms*— Slime coating, Bio – fouling, Coating for ship, Anti fouling.**

I. INTRODUCTION

A boat is a type of watercraft that comes in a variety of shapes and sizes, but it is generally smaller than a ship, which is differentiated by its bigger size, shape, cargo or seating capacity, or ability to transport boats. Small are typically found in inland waterways such as rivers and streams, as well as in coastal protected areas. Some boats, however, such as the whaleboat, were designed for use in an environmentally friendly manner. A boat is a vessel comparatively tiny enough to be carried onboard the ship in modern naval parlance. Boat proportions and construction methods vary designed for a specific purpose, available materials, or local traditions. Canoes have been used for mass transit, fishing, and recreation since ancient times and are still used today. Fishing boats differ. Styles vary widely, partly to accommodate local conditions. Ski boats, pontoon boats, and sailboats are examples of recreational boats. Houseboats can be used for short-term or long-term residence. Lighters transport cargo to and from large ships that can't get close to shore. Rescue and safety functions are provided by lifeboats. Manpower can be used to propel boats. (e.g. rowboats and paddle boats), Wind (for example, sailboats) and participate in the implementation engines (including gasoline, diesel, and electric). Within minutes of making contact with the water, marine biofilm tends to accumulate on the underwater portion of an oceangoing vessel. This buildup tends to increase the vessel's drag over time, increasing the vessel's physical resistance. Higher fuel consumption to preserve a given speed or reduced speeds at a maintained power will happen as a result of committing a foul drag on the vessel. Owners of ocean-going vessels invest significant time and money in mitigating the severity of fouling on vessel achievement. Mitigation can be accomplished through a variety of methods, including pretreating the hull surface in drydock and increased frequency of vessel drydocking, which typically occurs once a year. Depending just on age of the vessel, every 212 to three years or 5 years. Furthermore, obviously it depends on ship type, speed, trading area, activity rate (down time from ports), and based on geography voyage pattern, a wide range of coating makers and anti - fouling technologies are available.

The cost of hull treatment during a drydocking can vary from tens of thousands of dollars to many million dollars, depending on the vessel size, the type of coating system used, and the hull pretreatment prior to coating application. Among dry 2 cancelling, the vessel controller may perform hull deep cleaning or impeller polishing to restore some of the vessel's performance losses incurred by fouling and oxidation. Cleaning a hull costs between 10,000 and 30 000 USD, guess it depends on the portion of a underwater hull washed as well as the cleaning methodology used, and can take one to 3 days in port. Propeller polishing costs between 2000 and 5000 USD and can be completed in one day. TBT coatings were developed in the 1970s and have proven to have an outstanding capacity to inhibit fouling buildup, including slime, over a 20-year period. The International Maritime Organization's 2003 ban on TBT coatings prompted the development of numerous new coating systems. These contemporary alternatives contain less poisonous antiseptics; however, because they contain less efficient – or, in some cases, no – biocides, they are less effective The rate of committing a foul on vessel hulls is generally higher with the coating than the good-quality TBT predecessors. Provided higher fuel costs and gov't preferences in mitigating the bio risk affiliated with heavily clogged hulls, the benefits of efficient pretreatment and high-quality coating systems become much more important over a three - level or five-year drydocking interval. The desire to maintain high hull and propeller effectiveness in the overall picture of economic and. the sealant, the rate of fouling on vessel hulls is generally higher than with good-quality TBT predecessors. Provided higher fuel costs and governmental preferences in mitigating bio risk, the benefits of efficient pretreatment and high-quality protective coatings become more important over a 3- or five-year drydocking interval Environmental efficiencies have increased significantly in recent years, owing primarily to rising fuel prices, as well as increased pressure to reduce marine vessel emission levels and mitigate the migration of marine biofouling pests connected to the underwater component of vessel hulls. The section that follows will delve deeper into vessel performance and the impact of fouling just on speed–power connection for typical ocean - going vessels with displacement reaction husk. It is important to remember that as a whole CO2 and GHG emissions from sea going vessels are incredibly low (emissions per ton-mile of goods moved) in comparison to all forms of transport (Swedish Network for Transport and the Environment). Nonetheless, more efficient, non-toxic antifoulant systems for the hull's underwater portion will continue to benefit the industry.

II. Type of Boats

Boats are classified into three types: 1. Powerless or human-powered Rafts for one-way down - stream travel are examples of unpowered craft. Canoes, kayaks, gondolas, and ships propelled by poles, such as a punt, are examples of human-powered boats. 2. Sailboats propelled primarily by sails. 3. Motorboats that are catapulted by mechanical methods such as engines.

III. Fouling Organism

The buildup of debris on solid surfaces is referred to as committing a foul. Fouling materials could be living creatures (biofouling) or non-living substances (inorganic or organic). Fouling is differentiated from other natural events in that it occurs 3 on the surface of a component, system, or plant performing a specific and useful function, and the foulants process impedes or significantly interfere with this function

IV. Agents of Biofouling

The accumulation of microorganisms, plants, algae, or small animals where they are not wanted on surfaces such as ship and submarine hulls, devices such as water inlets, pipework, grates, ponds, and rivers that cause degradation to the item's primary purpose. When the host surface is another pathogen and the relationship is not parasitic, such accumulation is referred to as epibiotic. Because biofouling can happen almost anywhere there is water, it poses a risk to a wide range of objects, boat hulls and hardware, medical equipment and membranes, and entire industries, including making paper, food manufacturing, submerged construction, and desalination.

The following are the most common types of prevention methods used on ships:)

1. System of electrolysis
2. Dosing of chemical compounds
3. Ultrasonic machine
4. Electro-chlorination

1. **System of electrolyzes**: This is among the most widely used systems on ships to combat biofouling. The electrolytic system is made up of pairs of anodes made mostly of copper and aluminium (or iron). The anodes are attached to the sea breast or strainer. DC current flows through the copper anode material, producing charged particles that are conducted with the seawater all through the piping network.

2. Dosing of Chemicals: Chemical dosing is another common method for preventing maritime growth in piping networks. To allows users to track sea water boxes, anti-fouling chemicals including such ferrous chloride are used. The compound coats the pipes with a protective coating. To prevent corrosion, a ferrous layer is applied. 4

3. Ultrasound: Frequency surges are also used to keep marine growth at bay in piping systems. The ultrasonic system is thought to be one of the most effective methods for preventing biofouling. This method claims an 80 percent reduction in biofouling.

4. Chlorination by electrolysis: Electro-chlorination is a method of producing hypochlorite, which is used to avoid fouling, by generating chlorine. The depletion region is made of titanium. The negative electrode voltage is kept constant at 7 volts. Chlorine, along with other elements, is produced at the anodes to produce sodium hypochlorite. A huge concentration of hydrogen gas is also produced, which must be safely evacuated. The overlay at the anode is being consumed at a rapid rate a year at a rate of 6 mg/ampere It is, however, dependent on the supplied unit voltages and currents. The total chlorine output is determined by present instead of flow thru the component. As a result, sufficient flow is required to maintain cooling and prevent calcareous deposits. A concentration of 10ppm chlorine in sea water would quickly kill all marine life, whereas 1 PPM would then prevent fouling. It can be tested on the fly.

V. *What is Conventional Anti-Fouling Paint*

Antifoul also is known as bottom varnish or anti - fouling bottom nail polish. It is used by boaters to keep the nasties at bay, such as slime, weed, barnacles, and other lifeforms which love to grow under your ship and slow it down or eat it aside.
It works by using a biocide, that also implies 'existence agent.' Anti-fouling paint is a commercially available submerged hull paint (also known as bottom paint) that is applied to the hull of a ship or boat as the outer (outboard) layer to slow the growth and/or accommodate separation of concepts can be applied organisms that attach to the hull and can affect the vessel's performance and durability (see also biofouling). Pro paints are commonly used as one component of inter protective coatings, which may perform additional functions to antifouling, including such acting as a barrier against corrosion on wire hulls, which deteriorates and weakens the metal, or improving water flow past the hull of an angling vessel or high-performance racing yachts. Regardless of the fact that it will be commonly encountered as being applied.

VI. *How Fouling Agents Get on Boats?*

When microbes attach themselves to submerged objects such as boats, rope, pipes, and building structures, marine fouling occurs. Bivalves are among the worst offenders. They are hard to remove once attached, resulting in operations and maintenance downtime, increased energy consumption, and damage. Barnacles are marine growths that resemble small life forms (critters) such as small lobsters and shrimps, and they can be found on a boat hull that has been submerged for an extended period of time. They secrete a liquid glue that hardens into a strong cement-like material that adheres to the plate.

VII. *What Does the Term Antifouling Mean?*

Fouling is the accumulation of wreckage on hard substrates. Living beings (biofouling) and non-living substances can both be fouling materials (inorganic or organic). Anti-biofouling systems are coverings, paints, and surface coating applied to a solid (such as a hull) to monitor and control or inhibit pathogen connection. Copper cerium (or even other steel toxins) and/or other antiseptics, which are special substances that inhibit the growth of crabs, planktonic, and marine organisms, are now used in paints. Heretofore, copper wants to portray were red, so ship bottoms were still red.

VIII. *What is Being Done to Combat Antifouling Paint?*

Anti-fouling colorants are used to coat the leather boots of vessels to prevent sea life including such algae and mollusks from connecting oneself to the hull, trying to slow the boat down and rising fuel consumption., The IMO adopted an Assembly resolution requesting the MEPC to create a legally binding instrument to confront the same negative effects of pro systems used on ships. The decision called for a general ban on the use of antimicrobial organotin compounds in ship antifouling processes by Jan 1, 2003, and a lifetime ban by January 1, 2008. This device was later adopted as the Agreement 5 Made on the Regulation of Harmful Anti-fouling Systems on Vessels. According to the new Convention, "anti-fouling systems" are defined as "a coating, paint, or topcoat system." surface, paint A ship's outer layer or handset used to control or avoid accidental organism connection." Lime, and later arsenic, have been used to coat the bulkheads of sailing vessels until the synthetic chemistry industry developed powerful anti-paints based on metallic compounds. These compounds gradually "leach" into the seawater, attempting to kill barnacles and other ocean animals entangled with the ship. However, studies have shown that these drugs persist in the liquid, having killed sea life, causing environmental damage, and possibly trying to enter the food chain. The organometallic tributyltin (TBT), and have been shown to cause shellfish permanent deformation and whelk sex changes, is one of the most powerful anti-paints that emerged in the 1960s. Adoption of the new Convention The adoption of the new Conference marked the satisfactory completion of urged governments to act to reduce pollution from organometallic used in pro processes. In 1989, the International Maritime Organization (IMO) acknowledged that organotin compounds were harmful to the environment. The IMO's Marine Protection Of the environment Committee (MEPC) approved a decision in 1990 recommending that gov'ts enforce action to remove the use of Task elements pro paint on non-aluminum monohull vessels or less 25 meters long, as well as the use of pro-democracy wants to paint with leachate rates greater than four milligrams of TBT per day. In November 1999, the IMO Assembly was formed by a resolution requesting that the MEPC create a legally binding instrument to discuss the negative effects of anti-fouling processes used on ships. The resolution demanded that the use of Antimicrobials in antifouling processes on boats must be phased out by January 1, 2003, with a complete ban in place by January 1, 2008. This instrument was later adopted as the International Treaty to Regulate Harmful Anti-Fouling Processes on Ships

IX. *Coating with Slime it is Safe For The Environment*

Release coatings for fouling (FR). FR coatings' AF capability is based on the low and super baller surface they provide at the cellular scale, which prevents foulants adherence. They "make concessions a person's capacity to form good interaction bonds with the surface" due to their low surface energy. Because the reduced bonding, any accumulated biofilm will disassociate or be removed from the vessel while it is in motion due to the tensile and shear stresses caused by water motion. Consumers can buy sealant, hybrid, and hydrogel elastomers, which are the most common FR coverings on the market today. Their provider lifetime has been estimated to be between five and ten millennia (Lear's et al., 2012). In early studies, newly applied FR coatings outperformed erosional coatings in terms of durability. Disconnection occurs at vessel speeds greater than 8-10 knots, relying on the fouling type. As a result, the large bulk of FR coating materials perform badly at low speeds or in ships with frequent and/or long slack period (Hellion and Zebra 2009; Brassy 2009) and "require certain operations and maintenance profiles to function efficiently" (Hellion and Zebra 2009; Brassy 2009). (Chambers et al. 2006). Furthermore, FR coatings are prone to slime layer formation The presence of slime increases fuel consumption and co2 emission while also increasing the risk of aquatic invasive species translocation. As according Schultz et al. (2011), light and heavy slime can alter the performance of a Brings a great Burke-class destroyer respectively, in comparison to a hydraulically smooth hull. Unfortunately, slime removal necessitates extremely fast vessel speeds. Can dries (2001) observes that even at velocities exceeding 30 knots, slime detachment is difficult. Previously, a major shipping company discontinued the use of silicone FR coating materials on their container ships "due to the advent of slime layer and rapid decrease in efficiency" (Moller 2007). As a result, academic and industrial research is working on the importance of FR coatings with improved slime resistance. Most FR coatings have poor mechanical properties and poor adhesion, but we solved this issue by making it mechanical means strong and adhesion-friendly in nature. Our coating is also resistant to abrasion. And thereby reduce the growth on the hull.

MATERIALS AND METHODS

I. *Polyester Resin*

Polyester resins are synthetic resins that are created through the reaction of diamine organic acids and polyhydroxy ethyl alcohol. Hydride is a common raw material in polyester resins with diacid functionality. Monosaturated polyester resins are found in sheet molding chemical, bulk molded compound, and laser printer toner. Wall panels made of polyester resins bolstered with fiberglass, known as fiberglass reinforced plastic (FRP), are commonly used in eateries, kitchens, and other public spaces washrooms and other areas where washable, low-maintenance walls are required They're also widely used in healed pipe applications. In the United States, transportation departments require people for use as overlays on bridges and roads. They are recognized as PCO Polyester Concrete Overlays in this application. These are typically based on polyester resin acid and have a high styrene content—up to 50%. Polyesters, as well as epoxy-based materials, are used in anchor bolt adhesives. Many companies have introduced and continue to implement styrene-free systems, primarily due to odor concerns, but also due to concerns that monomer is a possible carcinogen. Potable water applications prefer styrene-free materials as well. Most polyesters are viscous, pale-colored liquids made up of a polyester solution. 6

II. *Liquid Starch*

Starch, also known as amylum, is a synthetic polymer carbohydrate made up of multiple glucose units linked together by glycosidic bonds. Most green plants produce this polysaccharide for energy storage. It is the most common carbohydrate in human diets worldwide, and it is abundant in traditional dishes such as wheat, lentils, maize (corn), rice, and cassava (manioc). Potato starch is a white powder with no taste or odor that is immiscible with water or alcohol. It is made up of two kinds of molecules: linear and helical amylopectin and branched amylopectin. Starch contains 20 to 25 percent amylose and 75 to 80 percent amylopectin by weight, depending on the plant. [4] Glycogen, an animal's glucose storage, is a more highly branched version of amylopectin.

III. *Borax Powder*

Borax is a hydrate salt of boric acid that is also recognized as sodium borate, potassium borate decahydrate, or sodium tetraborate decahydrate. It dissolves in water to form a basic, aqueous solution and is generally accessible in powder or granular form. It is soluble and has a wide range of business and home as a component in a variety of products. Pesticide; metal soldering flux (metallurgy); glaze and enamel manufacturing; tanning of skins and hides; artificial ageing of wood; as a disinfectant against cedar fungus; analytical chemistry as either a neutralizer; and biotechnological aid as an alkalizer are some of the applications. These are the weed-killing chemicals (i.e., unwanted plants)

IV. *Nylon Threads*

Nylon is a generic term for a class of synthetic polymers made up of nylon (repeating units linked by amide links). Polyester is a silk-like thermoplastic that is typically derived from petroleum and can be melted into fibres, films, or shapes. Nylon plastics can be mingled with a wide range of additives to produce a wide range of property variations. Nylon polymeric materials have found widespread commercial use in fabric and fibers.

V. *Chitosan Powder*

Chitosan is a natural polysaccharide made up of -(14)-linked E l (deacetylated unit) and F l (acetylated unit). It's made by treating shrimp and other crustaceans' chitin shells with an alkaline substance like sodium hydroxide. Chitosan has a variety of commercial and potential biomedical applications. It can be used as a plants treated and biopesticide in agriculture, assisting plants in fighting fungal infections. It can be used as a getting fined agent in winemaking, as well as to help prevent spoilage. It can be used in a self-healing urethane paint coating in industry. It is used in medicine to reduce bleeding and as an alternative to antibiotics in bandages; it can also be used to help deliver therapeutic through skin.

VI. *Fume Silicate*

Silica fume, also known as micro silica, is an abstract (non-crystalline) material made up of silicon dioxide, silica (CAS number 69012-64-2, EINECS total count 273-761-1). It is an ultrafine powder composed of globular particles size of 150 nm that was collected as a byproduct of the production of silicon and ferrosilicon alloys. The primary application is as a pozzolanic material in high-performance concrete. It is occasionally confused with silicon dioxide. Even so, the production, particulate characteristics, and application fields of fumed silica differ from those of mineral admixtures.

VII. *240 Grit Sandpaper*

Steel wool and glasspaper are two names for a type of wrapped abrasive made up of pieces of paper or cloth with asphalt emulsion glued to one face. There are numerous types of sandpaper, each with its own paper or backing, grit material, grit size, and bond. Sand and glass have been replaced in the modern manufacture of these products by other abrasive particles such as copper oxide or silicon carbide. When describing the paper, it is common to use the signature of the abrasive, such as "aluminum oxide paper" or "silicon carbide paper." Sandpaper is available in a variety of sieve sizes and is used to remove items from surfaces in order to smoothen them (for example, in painters and woodworking). finishing), removing a layer of material (including such old paint), or sometimes roughening the surface. There are numerous types of sandpaper, within each paper or backing, grit material, grit size, and bond. Sand and glass have been replaced in the modern manufacture of these products by other abrasives such as aluminum or silicon carbide. Sandpaper grit size is typically assigned a value that is roughly related to particle size. A small number, such as 20 or 40, denotes coarse grit, whereas a large number, such as 1500, denotes fine grit.

VIII. *Glass Fiber*

Glass fiber (or fiber glass) is a material made up of various extremely fine glass fibers. Fused glass has started experimenting with glass fibers all through history, but mass production of glass fiber was really only made feasible with the discovery of finer machine cutting tools. At the World's fair in 1893, Arthur Dumbarton Libbey displayed a dress made of glass fibers with the radius and mouthfeel of silk fibers. Glass fibers can be found in nature, such as Pele's hair. Glass wool, which is now referred to as "fiberglass," was invented as a thermal building insulation material by Games Slayer of Brock between 1932 and 1933. It is sold under the brand name Fiberglas, that also has since become a generic trademark. If used as a thermoelectric conductor, fiber glass Many small air cells are trapped, resulting in the wind reduced "crystal wool" product line Glass fiber has mechanical properties that are comparable to polymers and carbon fiber. Although it is not as rigid as carbon fiber, when used in composites, it is significantly less brittle. Glass fiber reinforced composite materials are used in 7 the marine and piping industries due to their good environmental resistance, good damage tolerance for dynamic loads, and high specific strength and stiffness. Glass strands Pele's hair, for example, can be found in nature. Games Slayer of Rollins invented glass wool, now known as "fiberglass," as a thermal building insulation material between 1932 and 1933. It is marketed as Identify a genericized trademark. Glass fiber, when used as a thermal insulator, creates a sense with a bonding material to trap a lot of small air cells.

IX. *Epoxy Resin*

Epoxy refers to the relatives of basic components or cured finished goods of epoxy resins. Epoxy resins, also known as in this, are reactants that are bifunctional alkaloids, acids (and anhydrides), phenols, alcohols, and thiols (usually called mercaptans). The pass reaction is a type of reactionary prepolymer and polymer that contains epoxide groups, and these core actants are also known as stabilizing agents or curatives. Epoxy functional groups are also known as epoxy functional groups. An oxirane's IUPAC abbreviation is an epoxide group. Epoxy resins can be reacted (cross-linked) with themselves or with a variety of co-reactants such as bifunctional amines, enzymes (and anhydrides), phenols, alcohols, and thiols via catalytic fibrillar reactions (usually called mercaptans). These co-reactants are commonly referred to as binder or curatives, and the pass reaction is referred to as curing.

EXPERIMENTAL

I. *Materials Used for Slime Coating*

Slime coating is made up of following materials such as glue, activator, silicone, polytetrafluorethylene, fume silicate.

Glue: Glue is a sticky material (usually a liquid) that can stick two or more things together. Glue can be made from plant or animal parts, or it can be made from oil-based chemicals. The first glues may have been natural liquids that come out of trees when they are cut. Later, people learned to make glue by boiling animal feet, cartilage or bones. Some very strong glues were first made from fish bones, rubber or milk. A simple glue can be made at home by mixing wheat, flour and water. This glue will stick pieces of paper together. Many kinds of art can be made using glue. A collage is a work of art made by using glue to stick coloured things onto paper. Some glues can be used to keep water out of boats, buildings or vehicles. In this case, the glue may be called caulk. Some man-made materials, including wood-like materials, are made using glues to bind together small pieces of material or powders.

II. *Activator*

There is several different SA. Here are all of the ones that I know of: Borax + water Saline solution + baking soda

Eye drops + baking soda. Certain brand of liquid detergents (I know that Tide and Gain work)

Liquid Starch Certain brands of lotion (just check the ingredients to see if it has sodium borate)

III. *Polytetrafluoroethylene*

Polytetrafluoroethylene is used as a non-stick coating for pans and other cookware. It is non-reactive, partly because of the strength of carbon–fluorine bonds, so it is often used in containers and pipework for reactive and corrosive chemicals. Where used as a lubricant, PTFE reduces friction, wear, and energy consumption of machinery. It is used as a graft material in surgery and as a coating on catheters.

IV. *Fume Silicate*

Silica fume, also known as microsilica, (CAS number 69012-64-2, EINECS number 273-761-1) is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete. It is sometimes confused with fumed silica (also known as pyrogenic silica, CAS number 112945-52-5). However, the production process, particle characteristics and fields of application of fumed silica are all different from those of silica fume.

COMPOSITION USED IN SLIME COATING

We created the glass fiber epoxy composite in handle process with dimensions of 10cm x 15cm We created a total of eight samples for testing. In composition part we made liquid starch and borax powder as constant value for each sample, liquid starch 25%, borax powder 25%, other materials like fume silicate and chitosan powder will be variable according to the composition. for each sample we need 10 grams of coating material. We convert 1 gram equals to 10%. (i.e. if we take 25% of borax powder refers to 2.5 grams of borax powder). Reason we make borax powder and liquid starch constant because they are supporting agents. The only changes take place in fume silicate and chitosan powder. Chitosan powder is available from the shell of crabs, lobster, and another hard-shell marine organism.

Materials	**Sample1**	**Sample2**	**Sample3**	**Sample4**	**Sample5**	**Sample6**	**Sample7**	**Sample8**
Borax Powder	25%	25%	25%	25%	25%	25%	25%	25%
Liquid Starch	25%	25%	25%	25%	25%	25%	25%	25%
Fume Silicate	25%	20%	10%	30%	40%	45%	5%	35%
Chitosan Powder	25%	30%	40%	20%	10%	5%	45%	15%
Total	100%	100%	100%	100%	100%	100%	100%	100%

TABLE 1 COMPOSITION RATIOS.

WATER ABSORPTION TEST:

Water absorption test carried out for all the eight samples. After applying the coating of various composition the samples allowed to completely dry for 12 hours. After that the samples are weighted and exposed to water absorption test. The following test results are listed below. The dry weight of each uncoated sample approximately 21 grams. After the application of coating material on the surface, the weight of each samples are approximately 31 grams. From the water absorption test we conclude the optimization of slime coating. It is test carried out for the given samples to measure the quantity of water absorbed by the specimen with respect to the given time. The (1) equation shows the calculation of water absorption test

$$\textbf{\%Absorption = Difference in weight / original weight x 100} \qquad (1)$$

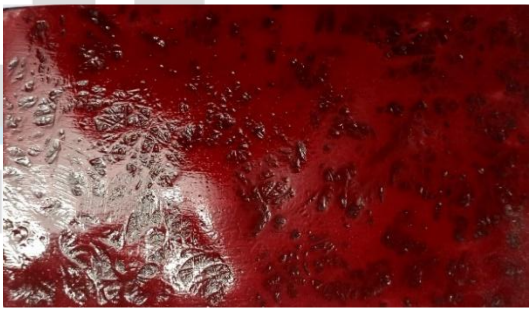
Sample No	**Wet Mass (grams)**	**Dry Mass(grams)**	**Water Absorption (%)**	**Quality of Samples**

1	33.0	32.6	1.22%	Average
2	33.3	32.8	1.52%	Average
3	32.7	32.2	1.6%	Average
4	33.4	33.0	1.21%	Average
5	33.4	32.9	0.91%	Good
6	32.2	32.1	0.30%	Excellent
7	32.7	32.1	1.86%	Average
8	33.5	33.1	1.2%	Average

TABLE 2 WATER ABSORPTION TEST RESULTS.

From the above TABLE 2 WATER ABSORPTION TEST RESULTS it is clear that sample 6 having excellent water absorption result. We are done a 24 hours water absorption test on each specimen. So, In sample 6 we get excellent results due to present of 25% of borax powder (approx. 2.5grams) and 25% of liquid starch (approx. 2.5grams) and 45% of fume silicate (approx. 4.5 grams) and 5% of chitosan powder (approx. 0.5grams). From the above results the optimized composition of the slime coating is present in sample 6. Further the sample is used for testing on real conditions with the comparison with conventional epoxy coating that are used in present situations.
We have done 10 months long during of real condition test carried out in ocean, with help of small boats used for fishing in country. At the end of the test we get a clear conclusion on present situation of the slime coating.

PHOTOGRAPHS

WITH CONVENTIONAL COATING (EPOXY BASED)	**WITH SLIME COATING**
 DAY 1 There is no growth occurs.	 DAY 1 There is no growth occurs in sample 6
 AFTER 2 MONTHS Algae started growing on surface	 AFTER 2 MONTHS Due to slime coating no growth occurs in sample6.

 More growth of mussels and sea snails are started growing.	 AFTER 4 MONTHS No growth occurs in sample 6.
 Started barnacle growth.	 No growth occurs in slime coating.
 Started spirorbids' growth occurs	 AFTER 8 MONTHS No growth occurs on sample 6.

 AFTER 9 MONTHS Growth of sponges and ascidians occurs.	 AFTER 9 MONTHS No growth occurs.
 AFTER 10 MONTHS Growth of sea worms, other organism occurs.	 AFTER 10 MONTHS: No growth occurs in slime-based coating in sample 6.

TABLE 3 PHOTOGRAPHY

CONCLUSION

From the above TABLE 3 PHOTOGRAPHY it is clear that sample 6 having excellent properties to fight against the bio fouling agents. For a long duration of real time test our sample 6 is passed in the test. Therefore, the optimization of slime coating composition is done in sample 6. The sample 6 composition of 25% liquid starch, 25% of borax powder, 45% of fume silicate and 5% of chitosan is best composition for the fouling coating. It also tested by the real time test for 10 months and water absorption test.

To reduce the carbon footprint, we need to improve the efficiency of marine ships, by using our slime coating it will improve efficiency and it doesn't create any harmfulness to marine eco system. It also improves life of ships. It reduces the drag of the ships.

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