

DOWNLOAD PDF 7 27. DEZINCIFIED (CORRODED PORTIONS OF SEA-WATER STRAINER 161

Chapter 1 : Corrosion Manual for Internal Corrosion of Water Distribution Systems

Diesel Engine Maintenance Training Manual Typical sea-water strainer Clogged sea-water strainer 7- Dezincified (corroded) portions of sea-water.

It is the main body of the torpedo, and may be called the "boiler room" of the torpedo. Herein are contained the compressed air, the fuel, and the water, which release the energy necessary to drive the mechanisms which propel and guide the torpedo. The forward, and by far the greater, portion of the air-flask section see Fig. Air alone, however, can not propel the torpedo for any useful distance at a sustained speed; but by combining the air with a highly volatile fuel and with water, in predetermined proportions, a gas and steam mixture is produced, which provides sufficient energy to propel the torpedo at its designated speed and range. Immediately adjoining the air compartment, at its after end, is the water compartment, which also contains the fuel flask. The midship section consists of the portion at the extreme after end of the air-flask section, where the air-flask section joins the afterbody, as shown in Fig. This midship section provides a space for housing and cooling the parts which convey the hot gases to the turbines to supply the power for propelling the torpedo. Openings are provided in the midship-section shell for access to and adjustment of the parts therein. The flow of air, water, and fuel from their respective compartments in the air-flask section to the operating mechanisms which are contained in the afterbody of the torpedo, is shown in the schematic diagram, Fig. Air-Flask Section Detail The air-flask section is cylindrical in shape, and of uniform outside diameter throughout its length. However, a smaller inside diameter at the guide stud location provides the necessary additional thickness 28 Figure Air-Flask Section, cut-away view, showing positions of the various fittings: The air flasks are of two types: The welded type is now being manufactured exclusively. The forged air flask is a cupped and drawn alloy steel forging, cylindrical in shape. To its after end is riveted and soldered the midship section, which thus becomes an integral part of the air-flask section. The welded air flask is made up of several forgings welded into a unit. The midship section is riveted and soldered to the after end of the air flask, thus becoming integral with the shell. Other differences between the forged and welded flasks which should be noted are as follows: In welded air flasks, air passes from the flask to the blow valve by way of a nipple screwed and sweated into the forward bulkhead dome on the vertical center line above the small bulkhead, and a pipe secured to the nipple by means of a nut. In the case of the welded air flask, however, during the hydraulic test the flask cannot be rotated in such a way that the air-outlet elbow for the blow valve is high enough to vent all air out of the flask when water is introduced; therefore, it was necessary to provide a vent on the top center line of the flask near the forward end to vent the air during the hydraulic test. This vent may also be used during flask overhaul by the service to drain the flask of any water in the air compartment. In the welded air flask the after bulkhead is integral with the flask shell. Air Compartment The air compartment, as shown in Figs. In the welded air flask both heads are integral with the air flask shell. In the forged air flask both ends of the air compartment are closed by dome-shaped bulkheads, held in place on ground seats by screws in the case of the forward bulkhead, and by threads on its outer rim in the case of the after bulkhead. Both bulkheads are held more securely on their seats by the air pressure in the flask. No lifting eye bolts are needed for manipulating the small bulkhead. When inserting the small bulkhead, the two flat sides of the bulkhead pass through slots in the seat; then it is turned so that the flat sides are seated clear of the slots. In both types of air flask, air is led into the air compartment, during charging, by way of the stop and charging valve, to be described later, through the main air-connection pipe, and the dry pipe. After charging, air is led from the air compartment through the dry pipe, the main air-connection pipe, and the stop and charging valve to the starting and reducing valve and the super-heating system. A central nut and nipple secure the forward end of the main air pipe to the after bulkhead. Another central nut and nipple secure the after end of the main air-connection pipe to the water compartment bulkhead. The dry pipe is provided to prevent water or oil from running into the main air-connection pipe when the torpedo is floating vertically at the end of an exercise or

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practice run. It is fitted and brazed into the nipple in the after bulkhead. The main air-connection pipe is coiled to allow for relative expansion and contraction in the air and water compartments. Blow Valve The blow valve, shown in Figs. It is manipulated from the exterior of the air flask shell. The free end of the pipe leading from the blow valve connects with a nipple in the pocket on the after bulkhead of the exercise head. Water Compartment The water compartment is forged integrally with, and is located immediately abaft, the air compartment see Figs. At its after end, the water compartment is closed by the water-compartment bulkhead, which is held against a ground ring seat at its after end. In addition to sealing the water compartment, the water compartment bulkhead supports the fuel flask by four brackets attached to its inner surface, as shown in Fig. It also provides an avenue for the main air-connection pipe through a central opening, also shown in Fig. Air from the air checks is led through a nipple in the reinforced portion of the water compartment bulkhead to a pipe leading to the top of the fuel flask; and the fuel is forced from the fuel flask to the fuel and water checks, by air pressure, through a pipe extending down into the bottom of the fuel flask, and through a nipple in the reinforced portion of the water-compartment bulkhead. Air from the air checks to the water compartment is delivered through a nipple, which replaces one of the bulkhead holding screws, to a pipe leading to the top of the water compartment. Water from the water compartment to the fuel and water checks is forced by air pressure through a pipe extending down into the bottom of the water compartment, and through a nipple which also replaces one of the bulkhead holding screws. These connections are shown in Fig. An opening in the top of the water compartment provides the filling hole for the water see "F" in Fig. When filling, the plug is removed from the filling hole in the top of the water compartment; then the plug is removed from the fuel Figure The Fuel Flask at left , and the Water-Compartment Bulkhead. The right and center views show the inner and outer faces of the water-compartment bulkhead. A Nipple for air to fuel flask; B Bosses for mounting fuel flask on water compartment bulkhead brackets; C Nipple for fuel to fuel strainer and check valve; D Fuel-filling hole; E Fuel-flask brackets; F Nipple for pipe to fuel strainer and check valve, connects with "C"; G Nipple for pipe from air check valve, connects with "A"; H Blow-out plug and nipple; I Opening for main air pipe. The flask is filled, the plug replaced; then the water compartment is filled. To protect against corrosion, the interior surfaces of the forged air flask are electroplated with cadmium. The interior surfaces of the welded air flask are coated with a baked phenolic resinoid coating. Blow-Out Plug To guard against destructive pressure, which might be built up in the water compartment by the absolute failure of the reducing valve, or to a rupture in the main air line passing through the water compartment, a blow-out plug Fig. The blow-out plug is located on the upper portion of the after face of the water-compartment bulkhead. See "H" in Fig. The arrangement of the blow-out plug is such that the plug will blow out at a pressure of about p. Fuel Flask The fuel flask see Figs. It is formed of brazing brass, and is tested to 50 p. The filling flange is located on top of the flask, so that it is directly under the water-filling flange, thereby giving access through the water-filling hole for removing and replacing the fuel-filling plug, and for filling the fuel flask. The air-inlet connection is located in the same fitting body as the fuel-filling plug, and enters the top of the flask as shown in Fig. The fuel outlet connection is located at the bottom of the flask, a perforated tube being provided to strain out large foreign particles. The air-inlet and the fuel-outlet nipples are connected by pipes to their respective nipples on the interior of the water compartment bulkhead, as shown in Fig. Midship Section The midship section see Figs. In both cases it becomes a permanent part of the air-flask section shell. The after end of the midship section is machined to form a joint with the afterbody. The midship section consists of a ring, closed at its forward end by the water compartment bulkhead see Fig. As has been previously stated, the mid-ship section provides a cooling chamber for those parts of the operating mechanisms which convey hot gases, and which must be externally cooled in order that they will not be injured by the interior temperature. The nature of these parts, therefore, as with all other parts found in the midship section, does not require the exclusion of water from their exterior surfaces. Hence, the midship section has openings which admit sea water and permit it to circulate freely through the section and around the parts which require cooling. Openings in the midship section also provide access for adjustment or manipulation of certain parts which are

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enclosed in the midship section. Among these parts are included those attached to the turbine bulkhead, which is the forward bulkhead of the afterbody, and which are known as the valve group and superheater. These will be described in the next chapter. The shell of the midship section is marked at each opening, indicating the parts to which access may be gained, these parts being the following: Major Fittings Attached to the Midship Section The stop and charging valve body, the air check valve body, the fuel and water check valve and strainer body, the speed-setting bracket, and the vent fitting, are all attached to the shell of the midship section, being held in place by screws, so they can be readily removed. These parts, with connecting pipes, are shown in Figs. Stop and Charging Valves The stop and charging valves are contained in one body, and are located at the top of the midship section, as shown in Fig. They are attached by screws to the top of the midship section shell, but connect with the main air pipe leading through the water compartment bulkhead. The charging valve provides a means for charging the air flask. A check valve under the charging valve prevents leakage of air outboard when the charging line is removed. The stop valve is operated manually and isolates the air in the air flask after charging and until it is ready for use. With the stop valve closed, the afterbody may be removed and overhauled while the air flask remains fully charged. A cut-away view of the stop and charging valve body is shown with the parts disassembled in Fig. For charging the air flask, the plug is removed from the charging valve, preventing the escape of air from the air flask. The charging-pipe connection is screwed into the threaded hole from which the plug is removed. The stop valve closes air-tight on its seat in the valve body. It has a plug which seats in the stop valve body against a washer. This plug has an opening which permits access to the valve-operating spindle for opening or closing the valve.

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Chapter 2 : Torpedoes Mark 14 and 23 Types

SPECIAL Diesel Engine Maintenance Training Manual. Clogged sea-water strainer 7- Dezincified (corroded) portions of sea-water strainer

Railway electrification system The subway system began during the War of Currents when Thomas Edison and his opponent, George Westinghouse , struggled over acceptance of direct current or alternating current as the standard way to deliver electricity. Alternating current became the standard for non-railroad purposes, but New York City Subway adopted direct current as more suitable for urban railroad purposes. To this day, the New York City Transit Authority converts alternating current to V DC third rail to power the trains, as do most transit railways around the world. The Triborough Plan comprised three new lines: The connections to the other two bridges were built; the Manhattan Bridge connection was cut in with the building of the Chrystie Street Connection. The BRT lines were built to wider profiles because the BRT did not want to use IRT trackage, which was narrower by comparison and carried far fewer passengers per hour. The design was inspired by the cars built for the Cambridge Subway Red Line which were designed based on the results of studies done on how best to design and operate a subway car that could carry the most passengers the most efficiently. The rolling stock , however, had to be the same track gauge so the trains could interoperate under the Dual Contracts. Along with the Brooklyn and North River Railroad , the two streetcar companies began operations on those tracks. When trackage was connected to the bridge in , the trolleys were moved to the upper level roadways until , when service was discontinued. The expansion of rapid transit was greatly facilitated by the signing of the Dual Contracts on March 19, The majority of the present-day subway system was either built or improved under these contracts. Under the terms of Contracts 3 and 4, the city would build new subway and elevated lines, rehabilitate and expand certain existing elevated lines, and lease them to the private companies for operation. The cost would be borne more-or-less equally by the city and the companies. As part of the contracts, the two companies were to share lines in Queens: The lines operated jointly and began from Queensboro Plaza. This practice lasted well into the municipal ownership of the lines and was not ended until This eventually led to their downfall and consolidation into city ownership in Instead of having trains go via Broadway, turn onto 42nd Street, and finally turn onto Park Avenue, there were two trunk lines connected by the 42nd Street Shuttle. The system was changed from a "Z" system to an "H" system. The line was extended northward with a new station at Grand Central and turned onto Lexington Avenue, where the line remained as four tracks. It was predicted that the subway extension would lead to the growth of the Lower West Side, and to neighborhoods such as Chelsea and Greenwich Village. South of Chambers Street, two branches were constructed. Only the northern part of the station was opened at this time, and piles of plaster, rails, and debris could be seen on the rest of the platforms. Finally, the new "H" system was implemented on August 1, , joining the two halves of the Broadwayâ€”Seventh Avenue Line, and the two halves of the Lexington Avenue Line. The completion of the "H" system doubled the capacity of the IRT system. These homes were affordable, about the same cost as the houses in Brooklyn and Manhattan. They helped alleviate densely population areas and probably helped save lives as people were no longer living in heavily diseased areas. The population in Manhattan below 59th Street decreased between the years of and Hylan was a strong advocate of public operation of the subway. He was fired from the BRT after working as a motorman for some time, and he wanted to avoid having to spend more money to recapture the IRT and BRT, so he tried to push the two operators out of business. To that end, Hylan had denied allocating money for the BRT by refusing to build new lines, refusing to raise fares thereby putting the BRT in more debt , denied building permits so that some major building work lasted longer than planned, and even refused to build a new subway yard for the BRT. The Malbone Street Wreck in contributed to the losses incurred by the two companies, which led to the bankruptcy of the BRT in The IRT was almost bankrupt, but managed to complete the line to Flushing by So, Hylan drew up plans for a third subway network, which would be built and operated in contrast to the existing

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subway lines, which were privately operated. The dual system could not keep pace with this ever-increasing ridership. The city, bolstered by political claims that the private companies were reaping profits at taxpayer expense, determined that it would build, equip and operate a new system itself, with private investment and without sharing the profits with private entities. Thus the city declared that it would operate it itself, formalizing a foregone conclusion. The first line opened without a formal ceremony. The trains began operating their regular schedules ahead of time, and all stations of the Eighth Avenue Line , from th Street in Inwood to Hudson Terminal now World Trade Center , opened simultaneously at one minute after midnight on September 10, The Great Depression resulted in soaring costs, and the expansion became unmanageable, so it was not built along with the other three IND trunk lines. Construction on the first phase of the IND was already behind schedule, and the city and state were no longer able to provide funding. A scaled-down proposal including a turnoff at 34th Street and a connection crosstown was postponed in By , construction had been postponed indefinitely, and Second Avenue was relegated to "proposed" status.

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Chapter 3 : Full text of "Diesel Engine Maintenance Training Manual"

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Nine escape from the downed aircraft following the forced landing. William Thomas Bell, 21, aerial photographer, who lived in Mayo, Florida , is recovered on Tuesday, 9 January, outside the plane from beneath the tail. The Eglin base public information officer identified the surviving crew as 1st Lt. Bidwell, instructor pilot; 1st Lt. Vere Short, pilot; 1st Lt. An enlisted man who witnessed the accident, stated that "bodies spilled out in every direction. The paratroopers were scheduled to "graduate" on 14 January. But officers later said they did not know the cause. Then I turned back to look at the gliders and saw a pile of debris out there. What I thought was debris turned out to be bodies. The Air Force identified twelve of the victims as: Jones, 25, instructor, Clay , West Virginia; Sgt. Rathberger, 23, Portland , Oregon; Pvt. Alfonso Romero, 18, Berkeley , California; Pvt. Runnell, 19, Creekside , Pennsylvania; Pvt. Smith, 23, Columbus , Georgia; Pvt. Toepfel, 18, Wisconsin Rapids , Wisconsin; Pvt. Vlands, 18, Holly Oak , Delaware; Pvt. Tomlinson, 19, Dover , Delaware; and Pvt. Wedeikis, 18, of Kenosha , Wisconsin. The name of the second pilot was withheld. Air Force officials at Smyrna Air Force Base , near Nashville, Tennessee, which has jurisdiction over training flights at Fort Benning, began a full investigation into the cause of the accident. These were the first glider fatalities at Fort Benning since Plane was making an approach to a landing strip when it encountered a cloud and broke off the approach. While circling around the mesa atop which the airstrip was located, it hit a steep slope in an upright position. Completely demolished by the ensuing impact and fire, killing all three men aboard, the classified cargo of HE detonator units in 22 boxes was destroyed " salvaged from the wreckage. As there was no evidence of sabotage , and since none of the detonators appeared to be missing, the incident was not reported to the Federal Bureau of Investigation. High explosives detonate on contact, large shockwave seen, 17 crew later bail out safely over Princess Royal Island , but five the first to depart the bomber are not recovered and are assumed to have come down in water and drowned. Wreckage found in September See also British Columbia B crash. The main wreckage comes down at Little Brickhill , near Bletchley. Right horizontal stabilizer peeled off, aircraft disintegrated, throwing pilot Charles Tucker clear, parachuted safely, but flight engineer Arthur Turton died in mishap. Cause was found to be high-frequency, low-amplitude aeroelastic flutter of both the vertical and horizontal stabilizers. Pilot okay, but Sea Fury written off. Outfitted with additional flight performance measuring instruments after the loss of the second YB on 5 June , the first YB converted from the second YB , being operated by an Air Force crew, piloted by Major Russell E. Schlee, [14] 19 February " 6 May [15] engaged in testing the stabilizer response during a high-speed taxi run, experiences a violent nose wheel shimmy. Before the aircraft can be brought under control, the nose gear collapses and the airframe breaks in two, destroying it. They were forced down in the rugged hills of Greene County, Pennsylvania near the town of Spragg. Each pilot crash landed on a different narrow, twisting two lane highway narrowly missing automobile traffic and several houses as they came in. Both aircraft were destroyed, but each pilot walked away from his aircraft with minor injuries. First flown 14 January , piloted by Ivan Ivashchenko, he is killed when the aircraft develops flutter which tears off his horizontal tail, causing a spin and crash. Lack of wing stiffness also resulted in aileron reversal, which was discovered and fixed. II , B, lost in storm over Tierra del Fuego , eleven killed. Wreckage finally found on a glacier on the Chilean side of Tierra del Fuego in They had landed in Charleston the previous day due to low fuel on a cross-country flight. Reinhardt, 43, and Capt. George Evans, 28, took off this date in morning marginal weather with low clouds and rain. A few minutes later, both aircraft nose-dived into the side yard of local landowner. Crew were rescued after which aircraft exploded. Pilot Pierre Gallay dies in the accident. One fully assembled bomb casing probably a Mark 4 nuclear bomb on board is completely shattered when triggers explode. A fissile pit, carried separately, was recovered. Complex gear design proves too fragile for aircraft weight. With repairs and strengthened gear, the bomber makes its first and only flight on 15 March but

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design is found to be underpowered and unstable and never again takes to the air. Aircraft entered uncontrollable spin, pilot bails out, parachute fails. Airframe is subsequently trucked to San Diego. Colquhoun makes a high-speed run over South Marston airfield, experiences a sudden nose-down pitch as the starboard wingtip folds upwards. He receives the George Medal for saving the aircraft under daunting circumstances. Ministry of Supply chief helicopter test pilot Squadron Leader F. Everest, is damaged in a belly landing after engine failure at Edwards AFB, California, [38] this date. Laughlin farm in Huddleston. The drivers turned their cars so the headlights shone on the scene. The crash sight was on fire and the stench of gasoline filled the air. Lynch remembers seeing plane and body parts strewn across the field. A former Army pastor, he was interested in erecting memorials at the sites of five military plane crashes that killed 13 men in Bedford County from to The community came together for the task, raising money and arranging dedication ceremonies. At the Huddleston crash site, a pound granite marker was dedicated on 10 November Despite a massive international air search, nothing is found. In February, two foresters discovered the wreckage in a remote area of Maine. The Sea Fury had struck a tree on top of the ridge with its port wing root and struck the ground within about feet. The force of the impact dug a 15 foot diameter crater and the aircraft broke up and scattered, within a 50 yard radius. There had been several small fires. Vought test pilot Paul Thayer ejects, parachutes into two feet of water, airframe impacts in dense woods on Drum Point island in the Patuxent River. Unable to get a relight, he attempts to roll the fighter inverted and unfastens his belt to drop out of the cockpit. One account states that the weather was clear, but Joe Baugher reports that bomber was in a storm system. Pilot is rescued by an American destroyer. Travis orders a return to the airfield. BB, , piloted by Ouris H. Cuerton, and BB, , piloted by Lyle N. Leavitt, both crash with crew fatalities during attempted bail-outs. Nine Britons, along with three Malaysians on board, are killed when the Dakota crashes into a ravine near Kampung Jendera, in the Sungai Beluar valley in the communist-infested jungles of Gua Musang, Kelantan. RAF records showed the plane, based in Changi, Singapore, had flown to Kota Baru with three crew and four despatchers. In Kota Baru, the aircraft picked up the five passengers and flew east of Kampung Jendera to drop a marker flare at a clearing for eight Lincoln bombers. It then rammed into trees and crashed into a ravine, killing all aboard. The crash happened when the country was struggling with communist insurgents, a period known as the Malayan Emergency 1948-1960, when British, Commonwealth and other security forces in Malaya fought the insurgents. Malaya finally won Independence on Aug 31, Navy personnel were killed, including 11 nurses. Roosevelt, and goes into the water directly off the bow, reportedly off of Guantanamo Bay, Cuba. Only Decker escapes from the wreckage with minor injuries to be rescued by the plane guard helicopter. Cause was possibly accidental engagement of the flight control gust locks. The noses of both are wrecked and both are written off. Small fire extinguished quickly but it is written off. Lawrence River near the town of St. Official Air Force explanation at the time is that the Superfortress released three conventional pound HE bombs. John Miles Stuckrath, pilot; 1st Lt. Lott, of Pensacola, Florida. He was a member of a Maxwell AFB unit. It cut a cyclonic gap through the immense trees for about yards and plowed into the 2,foot mountain near its peak. The impact of the crash sent one motor hurling feet down one side of the mountain, and the other motor landed feet down the opposite side.

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Chapter 4 : List of accidents and incidents involving military aircraft (â€“) - Wikipedia

Sea Water Corrosion 63 samples of each of these alloys withstood applied tensile stresses ranging between and ksi for up to years.

They provide a central source of information on the research, development, and demonstration activities in the Water Quality Office, in the Environmental Protection Agency, through inhouse research and grants and contracts with Federal, State, and local agencies, research institutions, and industrial organizations. The Water Quality Control Research Program has as its objective the development of the water quality control technology that will make such cities possible. Government Printing Office, Washington, D. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. Coupon-weight loss and linear polarization studies were employed to investigate the corrosion of typical materials of construction which might be subject to exposure to NTA in normal use in laundering. Detergent formulations used were representative of heavy-duty granular detergents. NTA-based detergents were more corrosive by a factor between 1 and 7 to the materials: In both soft and hard waters, corrosivity increased with increase of detergent concentration. Types and stainless steel and Nickel were very corrosion resistant. Cast iron showed extreme corrosion in NTA solutions with corrosion rates between 30 and mils per year. NTA detergents could increase metal ion pickup at a sewage plant by a factor between 1 and 7. At that time, nitrilotriacetic acid NTA was being employed increasingly as a phosphate substitute in detergents. Due to the lack of published data on the corrosion behavior of NTA, some concern was realized for its use as a phosphate substitute in detergents. The concern led to this research project on the corrosion behavior of materials commonly used in laundering in NTA-based detergents. The experimental work on this project began in September, , prior to the statement by the Environmental Protection Agency Administrator, William D. Ruckelhaus and Surgeon General Jesse L. Steinfeld on December 18, , concerning the use of NTA. In this statement, which is reproduced in full in Appendix A, the detergent manufacturers were commended for their voluntary action to discontinue the use of NTA. The results of this work indicated a significant increase in embryo toxicity and congenital abnormalities in rats and mice injected with dosages of two heavy metals cadmium and methyl mercury simultaneously with NTA compared to results with the same dosage of the metals alone. As indicated in the statement, other studies by both the industry and within the Government were underway at that time for further evaluation of NTA. The present work was allowed to continue as part of the further evaluation of this chemical. These conclusions related to the use of detergent formulations based upon NTA and sodium tripolyphosphate STPP contents typical of heavy-duty granular detergents at concentrations used by the average housewife in hot water washes at and F with soft 15 ppm hardness and hard ppm hardness water. NTA-based detergent solutions were almost always more corrosive to the materials: Corrosion was generally greatest in soft-water solutions and increased with increase of detergent concentration in both soft and hard water. Cast-iron soil-pipe material in the uncoated condition was not corrosion resistant to either NTA or STPP-based detergent solutions, with corrosion rates of 44 to 84 mils per year over extended periods of time. The materials used in laundering could be classified into the groups a very corrosion resistant; i. Corrosion was usually of a general, even nature but exceptions were die-cast zinc which exhibited mostly pitting corrosion, the carbon steel which exhibited a measurable amount of localized corrosion, and brass which exhibited dezincification in some STPP-based solutions. Weight-loss data were more reliable than those from the electrochemical linear polarization method with the possible exception of carbon steel, Types and stainless steel, and Nickel. This was due to the probably related formation of films which produced a low assessment of corrosion rate by the electrochemical method. Increase of detergent solution temperatures from to F had marginal effects on the corrosion behavior of the laundering construction materials. Therefore, caution should be exercised in the choice of materials with which they are to be used. It should be recognized

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that the NTA formulations in the absence of corrosion inhibitors, could give rise to as much as 7 times more metal-ion pick up in a sewage plant operation than for corresponding STPP formulations and thus methods for additional metal-ion removal need to be considered. Due to the recent voluntary removal of NTA from detergent formulations, the current interest in these detergent formulations as possible aggressive corrodents has decreased. However, a variety of detergent formulations based upon soda ash, silicates, borax, polyelectrolytes, or mixtures with other minor ingredients are now available as "phosphate free" and "NTA free" detergents. These formulations needed to be studied with regard to corrosion behavior of laundering materials in the same manner as for NTA. After discussion with detergent manufacturers, it is also apparent that porcelain ceramic should be added to the list of laundering materials since it is commonly employed and is not inert to corrosion in detergent solutions as might be anticipated. About 25 percent or 2. Although it is asserted that many other materials can stimulate eutrophication, detergent producers have searched for a substitute for STPP in detergents and cleaning agents. A complete lack of corrosion data in the open literature as evidenced by a state-of-the-art report Appendix B indicated a need for an understanding of the corrosion behavior of NTA-based detergents. This report describes the results of experimental work conducted to determine these effects. Effective February 1, , Chicago has regulated all laundry detergents to not contain more than 8. The addition of a detergent to the water makes it less hard and, therefore, generally more corrosive. The sequestering power of the builders can also lead to attack of scale on metals that may have already been present and thus present the opportunity for corrosion. On the other hand, phosphates can promote phosphate films on some metal surfaces which can provide some protection. As described later Appendix B , the greater sequestering ability of NTA over STPP coupled with a greater buffering capacity indicated a need for some concern of the corrosion behavior of NTA-based detergents toward metals. The concern for corrosion of materials used in laundering indicated a need for the study of the following metals: Discussions were conducted with representatives of a leading detergent producer to determine detergent formulations, detergent solution concentrations, and temperatures most representative of laundering conditions. The following facts were obtained and utilized in establishing the experimental program. As there is an insufficient difference in the chemical makeup of hot and cold water-type detergents, linear alkyl sulfonate LAS -based granular detergents suffice for evaluation purposes. It was believed, therefore, that corrosion studies needed to be conducted in a typical LAS-based granular detergent formulation such as: It was intended that such formulations would not include the presence of corrosion inhibitors, fluorescents, antitarnishing agents, brighteners, etc. One cup 76g of detergent powder per gallon washing machine, which corresponds to a 0. It appeared, therefore, that solution concentrations of 0. The average hot-water wash is about F but a minority employ F. Solutions entering the drain are normally about to F. These figures indicated that the majority of studies should be conducted at F but that some evaluations should also be made at F. The temperature of F also appeared applicable for studies relating to temporary conditions in a sewer system drain pipe. The hardness of the water is critical. Coupon Weight-loss data was considered the most reliable method of corrosion evaluation of the metals since electrochemical data in such environments is very limited. Coupon weight-loss data was, therefore, used as the major evaluation method. However, it was considered that limited electrochemical "linear polarization" studies could possibly aid evaluation due to its faster measuring ability and more sensitivity to low corrosion rates. Thus, the metals were representative of materials employed commercially in everyday use. The nominal chemical composition of the metals are given in Table 1. The cast-iron material was obtained from an unused section of common soil pipe employed in a sewer system; the determined chemical composition of the cast iron is also included in Table 1. Detergent Ingredients Basic chemical ingredients, as used in the preparation of typical heavy-duty type granular detergents, were obtained from a leading detergent manufacturer. A linear alkyl sulfonate LAS solution containing Fe Si ppm 10 5 2 1 1 Sodium nitrilotriacetic acid NTA as obtained from government sources was a mixture of commercial products. The sodium ion content indicated the presence of a small amount of free alkali in the salt. Impurities were identified at the following levels as parts per million by weight: The dilutions were made with water of either

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15 or ppm hardness. Each coupon was stamped with an identifying letter and number according to the following designation Table 2. Corrosion coupons were exposed to detergent formulations in in. A typical tube setup is shown in Figure 1a for the F temperature studies and in Figure 1b for the F temperature studies. In both setups, two coupons were supported on glass hooks attached to a central glass tube. The glass tube, in addition to aiding support of the coupons, allowed the introduction of compressed air into the tubes for continuous aeration and mild agitation of the solutions. Outlets were provided at the top of the tubes for the air. As shown in Figure 1b the tubes for F temperature studies included water condensers to prevent the loss of solution due to evaporation. Condensers were not required for the studies at F. Each tube employed ml of detergent solution which was sufficient to cover the coupons by several inches. Heating of the blocks was readily conducted by attachment of bar heating elements to the sides of the blocks. Coupons were exposed for 2, 5, 11, and 14 days, depending upon the metal, and in all cases the solutions were continuously aerated by the bubbling through of air which also provided mild agitation. To prevent contamination of solutions with other metals, special attention was made to use each tube with only one type of metal under study. Coupon Descaling and Corrosion Evaluation To evaluate corrosion of coupons by weight- loss, it was necessary to descale the exposed specimens. Many of the adopted descaling procedures were recommended practice. Light scrub with bristle brush under running water. Scrub with bristle brush under running water. After descaling, the coupons were rinsed with water, washed with acetone, dried and reweighed to determine weight loss. Table 4 gives the areas of the various metal coupons, the density of the metals and the conversion factors from mdd to mpy. The difference in area between the coupons was due to the difference in sheet thickness of the metals. After descaling procedures had been completed and corrosion rates calculated, the coupons were examined metallographically. For these studies, electrodes of the metals, tabulated in Table 1, were prepared. The corrosion rates were determined using the linear polarization method. Duplicate electrodes were used with electrode areas facing each other 1 in. The electrodes were shorted during periods of no measurement. Continuous aeration and mild agitation in each cell was provided by the entry of air through a glass tube. Figure 3 shows the electrical circuit for conducting the electrochemical corrosion-rate measurements using the linear polarization method. The microswitch was activated by a cam attached to a continuously variable speed motor such that dc power to the electrochemical cell could be reversed for times up to every 3 minutes. By adjustment of the potentiometer "A1 a steady and reversible mV signal AE could be imposed across the terminals of the electrochemical cell. This voltage drop was fed to a sensitive re- corder Honeywell, Electronik

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4 *TechnologicPapersoftheBureauofStandards* *literature*thedescriptionofthevariousformsinwhichitmay occurandofthechangesproducedinthemetalbywhichitmay.*

The wetted instrument includes valves for city water, feedwater or hot water, pipe joints, strainers, water faucet clasps, pump supplies materials, water meters, water purifiers, water feeders, hot water feeders or other such wetted instruments each made of copper alloy, such as bronze, brass, etc. The nickel elution prevention method for the wetted instrument of copper alloy includes applying the protective film formation agent containing at least one species of benzotriazole, benzotriazole derivatives and organic acids including a straight-chain fatty acid to at least a wetted surface of the wetted instrument of copper alloy to form a protective film, thereby suppressing elution of nickel via the protective film. Description TECHNICAL FIELD The present invention relates to a method for preventing elution of nickel from a wetted instrument of copper alloy, a protective film formation agent for preventing the elution of nickel and a detergent for preventing the elution of nickel. BACKGROUND ART Generally, valves for city water, feedwater or hot water, pipe joints, strainers, water faucet clasps, pump supplies materials, water meters, water purifiers, water feeders, hot water feeders or other such wetted instruments are provided at halfway or end sections of pipes for city water, feedwater or hot water. These wetted instruments are almost made of copper alloy, such as bronze or brass excellent in castability, mechanical machinability and economical efficiency. Particularly, in valves, joints, etc. When the instruments made of bronze or brass containing lead are exposed to a fluid, such as city water, however, a lead component of the lead-containing metal deposited on the wetted surface layer is possibly eluted into the city water. In view of the above, the water quality standards of city water as a beverage have been prescribed by the rating identification method carried out in accordance with the specific procedure. City water has to meet the water quality standards. Since lead is a substance harmful to human bodies and the amount of lead leached has to be reduced as much as possible, restrictions on the lead leaching standard came to strengthening in April, in Japan. Under these circumstances, wetted instruments of copper alloy produced using a so-called leadless material having lead removed from a fodder and wetted instruments of copper alloy having the elution of lead reduced through surface treatments for a conventional lead-containing material including an acid or alkali cleaning treatment go into circulation. For example, lead elution reduction techniques are described in the following refer, for example, to Patent Documents 1 to 3. The lead elution prevention method described in Japanese Patent No. In particular, by using benzotriazole BTA in place of the hydrochloric acid as an inhibitor, tarnish and corrosion are suppressed. JP-A Patent Document 2 discloses, as a lead elution prevention technique, a lead elution prevention treatment method comprising immersing a clasp for feedwater and wastewater in a solution of any of benzotriazole-based compounds to form a film attached firmly to the surface of the clasp. JP-A Patent Document 3 discloses, as a lead removing technique, a lead elution prevention treatment method comprising immersing a clasp for feedwater and wastewater in an etching treatment solution containing an organic carboxylic acid or a salt thereof. In addition to the improvement in the prevention of lead elution as described above, an improvement in elution prevention of nickel adversely affecting human bodies has now been calling for urgent attention. Valves, pipe joints, water faucet clasps and other such wetted instruments are subjected to various kinds of plating treatments, commencing with nickel-plating treatment, for the purpose of enhancing the exterior beauty, corrosion resistance and abrasion resistance. Examples of plating treatments include nickel-plating, nickel-alloy-plating, nickel-chromium-plating and nickel-tin-plating treatments. When these nickel-based plating treatments have been adopted, the coat wraps around and adheres to the spout section of a wetted instrument. As shown in FIG. This is why the nickel coat 2 b rather than the chromium coat 2 a wraps around the inward portion of the spout section due to the difference in current density range between the two. In this state, when a fluid, such as city water, is supplied to the wetted instrument 1, there is a possibility of nickel of the nickel coat 2 b being

eluted into the fluid. Furthermore, the nickel coat 2 b has a plurality of pinholes 2 c and, of the pinholes, there exist those reaching the copper surface constituting the under layer of the nickel coat 2 b. In consequence of a fluid exhibiting good electric conductivity, such as city water, having entered the pinholes, bimetallic corrosion is also generated there. Moreover, nickel is also eluted from the nickel coat 2 b per se. The nickel elution reduction technique is disclosed in the following refer, for example, to Patent Document 4 or 5. The nickel elution reduction treatment method described in JP-A Patent Document 4, for example, comprises the steps of plating a water feeder made of copper or copper alloy with nickel, plating the nickel coat surface with chromium and removing the nickel coat running out the chromium coat. In the nickel-removing step, the water feeder is immersed in an oxidizing chemical, such as a sulfuric acid, for removing the nickel coat alone by dissolution. Thus, the nickel coat that has wrapped around the spout at the nickel-plating treatment can be removed by dissolution. JP-A Patent Document 3: JP-A Patent Document 4: JP-A Patent Document 5: Thus, the technical effect thereof cannot be confirmed. In JP-A Patent Document 4 with the aim of reducing nickel elution, the nickel coat running out the chromium coat cannot effectively be removed and, since the nickel coat always remains at the wetted section, the nickel component is eluted from this section electrically conductive via a fluid, such as city water, to generate bimetallic corrosion and from the nickel coat per se. Thus, the nickel elution standards cannot satisfactorily be fulfilled at all. In addition, exfoliation of the nickel coat allows copper that is the bare metal to be exposed, and there is a possibility of lead segregated on the surface layer being eluted. Thus, the technical effect thereof cannot be judged. In view of the above, a test was conducted under the same conditions as in JP-A Patent Document 4 to confirm the technical effect of nickel removal. Though described later in detail in Example 1, the measurement results are shown in Table 6 showing sample No. An offset was obtained based on the actual measurement. Though described later, the offset is a numerical value to be compared with the elution standards. As shown in the same table, the amount of lead eluted was 0. Thus, it was confirmed that the two amounts were too large to satisfy the elution standards, respectively. According to water mixing valves known to have a large amount of nickel elution, therefore, in a sample, the portion of the nickel coat exposed only at the portion that wraps around the spout has an area of mm². A merely acid-cleaned actual product that has a wetted portion having substantially the same area as the test piece has no longer satisfied the strict nickel elution standards. The present inventors have further elucidated the causes of lead elution and nickel elution in this kind of field. Incidentally, reference numeral 3 in FIG. As shown in FIGS. As is clear from the electron micrograph of FIG. Valves, pipe joints, strainers, water faucet clasps or other water feeders having complicated flow paths are formed of a copper alloy material by sand casting. The casting surface thus cast is bumpy and, at the dent portions thereof, lead 5 moved from a crystal grain boundary 4 to the surface layer at the time of the solidification is segregated. Particularly at the inside surface layer of a water feeder not subjected to surface treatment, the segregation is conspicuous. When plating treatment is performed in this state, the plating solution stays on the lead 5 at the dent portion and dries there and consequently it is conceivable that a nickel salt 6 different from metallic nickel adheres to the lead 5. Since a water feeder, such as a water faucet clasp, has complicated flow paths and since the plating solution staying inside is difficult to eliminate, it is conceivable that adherence of the nickel salt 6 becomes conspicuous. When a fluid, such as city water, is supplied to the water feeder in this state, the lead 5 and nickel salt 6 are eluted. In the Patent Documents mentioned above and other prior art, this point is not taken into consideration. Even when adopting the technique of JP-A Patent Document 2 to form a film of benzotriazole 33 on lead 31 segregated on a crystal grain boundary 30 as shown in FIG. Also as shown in the same figure, since the film of benzotriazole 33 is not formed on a nickel salt 32 that is not a metal, elution of the nickel salt 32 consequently proceeds and subsequently a large amount of segregated lead 31 under it is eluted. Thus, it is impossible to prevent elution of both nickel and lead. Here, the following test was conducted to confirm the effect of reducing leaching of lead by benzotriazole. The other test piece was untreated. The two test pieces were tested for leaching of lead based on JIS S no conditioning and hour immersion. The test results are as shown in Table 1 below.

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Chapter 6 : History of the New York City Subway - Wikipedia

*ABYC Standard H Seacocks, Thru-hull Connections, and Drain Plugs*⁸ All materials shall be galvanically compatible and resist degradation to salt water, petroleum products, UV light, ozone, cleaning components likely to be encountered, marine growth.

The method includes the steps of: It is well-known that the mechanical cleaning of a filter surface can be accomplished by having a brush or scraper drag along the filter surface where deposits have accumulated. In certain configurations, the brush or scraper is mounted at one end between two walls but with a significant portion of the brush or scraper projecting beyond the walls. Such configurations are shown in U. In conventional filter systems, the particulate contaminants are driven off the filter surface and are deposited in a hopper or tank along with the fluid being filtered, thus discarding large amounts of the fluid being filtered. The use of a brush, or high speed cleaning spray, disposed between a pair of walls for cleaning a cylindrical filter is known in the art, as is disclosed in U. Another variation employs a backwash that drives the particulate contaminants off of the cylindrical filter, as is disclosed in U. An exemplary use of such filters is in a water desalination system that is available on ships. As a result, where these small particulate contaminants are captured by a downstream strainer e. Therefore, there remains a need for a cleaning device that can dislodge such extremely small particulate contaminants off of the downstream strainer surface, as well as from within the strainer surface, and then ensure that these particulate contaminants flow out through the drain rather than re-attaching to the strainer surface. It is to just such a system that the present invention is directed. As mentioned earlier, the particulate contaminants that need to be removed from the water flow are extremely small, less than microns, and a large percentage of these less than 25 microns, therefore do not settle out by gravity. The invention of the present application is well-suited to removing these small particulate contaminants from the water flow and into a drain. In particular, a water filter is disposed within a water flow having particulate contaminants therein. The water filter comprises: A method is provided for cleaning a water flow having particulate contaminants therein. The method comprises the steps of: A water cleaning system is provided for use with a water flow having particulate contaminants therein. The cleaning system comprises: A method is provided for cleaning a contaminated water flow having particulate contaminants therein. A water filter system for use with a water flow having particulate contaminants therein. The water filter system comprises: The present invention is characterized as a non-disposable cleaning device, i. The term non-disposable is defined as an item that does not require periodic replacement, e. Thus, such a non-disposable item has obvious advantages in environments where storage is limited and cleaning device replenishment facilities are unavailable, e. Other example systems include power plants, cogeneration facilities, etc. As an exemplary environment, Applicants have depicted a water desalination system 1 for disclosing the preferred embodiment; such a water desalination system 1 may be used on watercraft, e. However, it should be understood that it is within the broadest scope of the present invention that it can be used in any water cleaning system and it is not limited to a water desalination system. Referring now in greater detail to the various figures of the drawing, wherein like reference characters refer to like parts, there is shown in FIG. The wedge wire filter 5 discharges to the self-cleaning wire cloth e. As shown more clearly in FIG. Each canister 26 and 28 has two inputs from the common manifold 30, as indicated by inputs 32A and 32B for canister 26 and by inputs 34A and 34B for canister. Each canister 26 and 28 comprises a cylindrical-shaped porous member 36 and 38, respectively, through which the sea water flows, as will be discussed in detail later. The porous members 36 and 38 comprise a screen selected from the group consisting of wedge wire, wire cloth and perforated metal. In the preferred embodiment, the porous members 36 and 38 comprise wedge wire screens, such as those manufactured by Leem Filtration Products, Inc. It is also within the broadest scope of the present invention that the porous members 36 and 38 may comprise wire cloth or perforated metal, as opposed to wedge wire screens. One of the main features of the water filter is its ability to filter out fine particulate

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matter, e. Drive mechanisms 40 and 42 FIG. Otherwise, during normal operation, the porous members 36 and 38 remain stationary. As can be seen in FIG. Sea water flow through the porous member is more easily depicted in FIG. The main sea water flow is through the porous member 36, from an outside surface 37 to an inside surface 39, as indicated by the arrows 52, and down through the hollow interior 41 of the porous member. As the sea water then flows through the porous member 36, particulate contaminants are then trapped against the outer surface 37 of the porous member. The filtered sea water exits into a main output 54 of the canister, as shown by the arrow. Thus, sea water flow through the filter is basically continuous. When cleaning of the porous member 36 and 38 is required, as indicated by pressure drop across the filter as measured by a pressure transducer, not shown, the drive mechanisms 40 and 42 are activated to rotate the respective porous members. In addition, solenoid valves 72 and 74 FIG. Furthermore, it is within the broadest scope of this invention to include other alternative locations for the drain, e. Opening of the drain 76 or the alternative drain is kept to a minimum to discard as little sea water as possible while flushing the particulate contaminants from the chamber. Thus, for example, the drain 76 can be open all or any part of the time that the porous members 36 and 38 are rotating. Cleaning of the porous members 36 and 38 is accomplished by the particulate-removing means, only one of which is shown most clearly in FIGS. In the preferred embodiment, the particulate-removing means comprises an elongated wire brush 62 that spans the length of the porous member. The brush fibers are in contact with the outside surface 37 of the porous screen 36 and thus bear on the outside surface 37 of the porous member 36 along its entire length. The brush 62 forms the separation between the two dislodge subchambers 50A and 50B, while the majority of a brush support 63 is disposed inside the drain subchamber 50C, as shown in FIG. The purpose of these walls 64A and 64B is to contain the dislodged particulate debris within the chamber 50 so that substantially only sea water within this chamber 50 will be discharged through the drain 76 or alternative drain, to be discussed later during cleaning. The base wall is secured between a particulate-removing means e. Because of the size of the apertures e. A drain passageway 75, through a strainer support housing 77, is also shown in FIG. At the extreme ends of the confining walls 64A and 64B, respective wipers 65A and 65B are secured to the outside surfaces of the walls 64A and 64B, respectively, and which also run the length of the porous member. The wipers 65A and 65B e. As can be seen most clearly in FIG. These shoes 67 e. The drain subchamber 50C is in direct fluid communication with the drain 76 or alternative drain. When the drain 76 or alternative drain is open, any particulate contaminants suspended in the dislodge subchamber 50A are pulled toward the apertures in the partition and pass through them and out to the drain 76 or. Any remaining particulate contaminants which cannot be mechanically driven off of the surface 37 by the brush 62, e. In particular, unlike the first dislodge subchamber 50A which is not totally closed off since the wiper 65A stands off from the outside surface 37 of the porous member 36, the second dislodge subchamber 50B forms a completely-closed off chamber because the wiper 65B does not include shoes and, therefore, is in contact with the outer surface 37 along its entire length. Thus, the second dislodge subchamber 50B is subjected completely to the influence of the pressure differential created between the inside surface 39 of the porous member 36 and the opened drain pressure which is present in the drain subchamber 50C, via the apertures. When the drain 76 or is open, these particulate contaminants, lodged in between the outer surface 37 and the inside surface 39 of the porous member 36, are driven out of that region by the reverse pressure differential and then are suspended in the second dislodge subchamber 50B; this pressure differential also pulls these particulate contaminants toward the apertures in the partition and into the drain subchamber 50C for passage through the drain 76 or. As pointed out earlier, the particulate contaminants are of an extremely small size, less than microns, and a large percentage of these are less than 25 microns; as a result, these particulate contaminants do not settle out by gravity into the drain but rather, due to their small size, remain suspended in the sea water. The invention of the present application is well suited to overcome this problem as described below. It should be understood that the apertures provide for fluid communication between the first dislodge subchamber 50A and the drain subchamber 50C and for fluid communication between the second dislodge subchamber 50B and the drain

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subchamber 50C. However, because the apertures are small, they maintain a high velocity of particulate contaminants from both the first and second dislodge subchambers 50A and 50B into the drain subchamber 50C under the influence of the reverse pressure differential. Such a high velocity cannot be sustained by replacing the apertures with a slot. Furthermore, replacing the apertures with a slot would defeat the purpose of maintaining the transferred particulate contaminants. In particular, the advantage of using the plurality of apertures, as opposed to a slot of the type shown in U. For example, if there are 21 apertures that form one set of apertures in the partition, each having a diameter of approximately 0. If, on the other hand, a slot having a width of 0. The higher velocity significantly reduces the chance that a particulate will migrate backwards through the plurality of apertures and reattach to the porous surface. It is also within the broadest scope of the present invention to include an alternative drain configuration as shown most clearly in FIGS. To that end, a drain is depicted along side the drain subchamber 50C rather than disposed underneath the subchamber 50C, as discussed, previously. The drain comprises drain passageways, and that form a portion of the particulate-removing means support. The passageways are coupled at one end to a common manifold through which the dislodged particulate contaminants are disposed of. As shown in FIG. Thus, when a drain solenoid valve FIG. From there, the dislodged particulate contaminants are driven into the cross holes, through the passageways and then into the common manifold. Alternatively, instead of using a single solenoid valve, it is within the broadest scope of this invention to include dedicated solenoid valves, and FIG. It is also within the broadest scope of the present invention that the term particulate-removing means include a brush, a scraper, or any equivalent device that is used to dislodge particulate contaminants from the outside surface 37 of the porous members 36 and. For example, where larger particulate contaminants are to be filtered from the water flow, a scraper not shown can be used in place of the brush. It is also within the broadest scope of the present invention that the particulate-removing means also encompasses a reverse flow of clean water for dislodging the particulate contaminants from the water filter; or a reverse flow of clean water in combination with the particulate-removing member e. In particular, as shown in FIGS. The elongated spraying element is coupled to a pressure source e. As shown most clearly in FIG. Thus, as the porous member 36 is rotated direction indicated by the arrow during cleaning, the high energy spray drives the particulate contaminants from the outside surface 39 into the dislodge subchamber 50B. It should be understood that the particulate-removing means may comprise the elongated spraying element alone for driving off the particulate contaminants, or the particulate-removing means may comprise a particulate-removing member e. Together, the elongated spraying element and the particulate-removing member e. When the particulate-removing member e. The porous member 36, for use in this second embodiment, comprises an open lower end FIG. Another variation of the self-cleaning water filter that utilizes a reverse flow of clean water for cleaning purposes is depicted at in FIG. In particular, as indicated by the arrow, during normal operation, sea water enters through an inlet valve to a water filter

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Chapter 7 : Corrosion Potential of NTA (Nitrilotriacetic Acid) in Detergent Formulations

A pump 2 pumps sea water into a ... (direction of rotation is shown by the arrow in FIG. 7), Method of cleaning a cylindrical water strainer utilizing.

The factors which affect the amount and rate of corrosion may be divided into chemical, physical, and biological. An overall summary of these environmental factors and their relation to iron corrosion is presented in Table 3. The roles of oxygen, biological activity, temperature, velocity, salinity, and pH are discussed in more detail in the following paragraphs.

Oxygen The dissolved oxygen content is a major factor affecting the corrosivity of seawater. For many common metals, a higher oxygen content is accompanied by an increase in the rate of attack. This results from the fact that corrosion rate of local anodes is dependent on the cathode reaction. Depolarization is more rapid with the increase in arrival of oxygen at the cathode, and this in turn is a function of the amount dissolved in the seawater and the velocity of flow at the surface. Water low in oxygen flowing at a high velocity could provide as much oxygen to the cathodic surface as water high in oxygen moving slowly past the surface. The oxygen level in seawater may range up to 12 ppm.

4. Photosynthesis of green plants, wave action, etc. For a given location, seasonal variation in oxygen level resulting from the above actions will, in turn, influence corrosion behavior. A variety of other biofouling organisms also are found associated with the above types, some of which have a degree or more of mobility. For metals like copper and iron, complete elimination of oxygen will reduce the corrosion to negligible amounts. This method is under active study for control of corrosion in desalination equipment.

Fouling is a major factor in the performance of marine facilities. Structures in the water can be overloaded by the extra weight of fouling; buoys can lose buoyancy, and fuel consumption becomes excessive on the badly fouled hulls of ocean-going vessels. Metals depending on a passive film for corrosion protection, e.

Biological Activity When a metal or other surface is first immersed in seawater, a biological slime tends to develop in a matter of hours. Some authorities consider this film of living bacteria and other microorganisms to be attractive to embryonic fouling organisms looking for a place to settle. During an active season, a great variety of organisms are found on an immersed surface. Usually of most concern, from a corrosion point of view, are the sessile organisms. They arrive at the slime-covered surfaces in minute embryonic form and become firmly attached. Once attached, they rapidly transform to the mature form and become immobile. Clapp, on page of Reference 4, lists the following most common forms of sessile fouling organisms: Annelids Barnacles Encrusting bryzoa Mollusks Corals. An increase in temperature normally is expected to speed up a chemical reaction according to thermodynamic considerations. This also would be the case for the corrosion reaction in seawater were it possible to hold all other variables fixed. Since it is not normally possible to do this, the effect of temperature has to be established indirectly. Oxygen solubility decreases with increase in temperature; biological activity increases as one goes from, e. For temperature variations of a seasonal nature, iron, copper, and many of their alloys show a higher rate of attack during the warm months. On the other hand, when seawater is heated at atmospheric pressure, it loses dissolved gases, especially oxygen, and it has a tendency to precipitate a protective scale. Both these actions tend to reduce the attack.

Velocity Many metals are sensitive to velocity effects in seawater. For metals like iron or copper, there is a critical velocity, beyond which corrosion becomes excessive. Special forms of corrosion are associated with seawater velocity, e.

Salinity The major oceans of the world are completely connected in the Southern hemisphere and mixing is continuous. It is important to note that, in most cases, the relative proportion of salts does not vary appreciably in interconnected seas. Variations in salinity in open-ocean surface water typically range from 32 to In this range, the corrosion of common metals is not appreciably affected. Salinity is usually determined by measurement of chlorinity i. Since the salinity variations are accompanied by other changes, the total effect on the corrosion behavior has to be established in each case. Diluted seawater, as found in mouths of rivers, may be more corrosive even though the electrolyte itself may be less aggressive. Ordinary seawater is usually more saturated with respect

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to carbonate solubility; in diluted seawater, however, an unsaturated condition exists and there is less tendency to form protective carbonate-type scale which, in effect, increases corrosivity. Marine-organism activity is reduced or eliminated in diluted seawater, and there may be less tendency to form a protective layer of biofouling. Plant matter consumes carbon dioxide and affects the pH during daylight hours. The carbon dioxide content in seawater is influenced, close to the surface, by the exchange with carbon dioxide in the atmosphere. The slight daily shift in pH from, say, 8. As pressure is increased, pH is reduced according to thermodynamic considerations. Thus, at great depths, there is some evidence of less tendency for protective carbonate-type scale formation.

Forms of Corrosion The factors which affect the corrosion of exposed metal surfaces in the different environmental zones have been discussed in the preceding sections. When actual metal structures are exposed to these ocean environments certain types of attack are most commonly experienced. The most common forms of corrosion for environments are galvanic corrosion, pitting, and crevice attack. Sand or dust erosion by wind action can augment corrosion in a marine atmosphere, whereas seawater velocity effects such as impingement or cavitation may be important in an application involving underwater service.

Galvanic Attack Because seawater is an excellent electrolyte, severe corrosion often occurs when two different metals are coupled together and exposed to a marine environment. One metal in the couple will be anodic to the other. The degree of attack depends partly on the relative position of the two metals in the galvanic series for seawater. A galvanic series for flowing seawater is presented in Table 6. Usually the farther apart in the series, i. However, polarization effects tend to alter the behavior. In seawater, coupling of titanium or stainless steel to carbon steel tends to cause less acceleration of attack than coupling of copper to steel, because the former two metals are more readily polarized than the latter. It can be shown for a metal like carbon steel, whose corrosion rate is usually controlled by the total cathodic area available, that the ratio between the area of the cathode and the anode is important. A small anode e. The reverse situation of a small cathode coupled to a large anode will have only a minor influence on the rate of attack. To control or prevent the accelerated attack involved in a galvanic couple, certain principles should be observed. First, the possibility of breaking the electrical circuit by providing an insulating barrier at the junction of the two metals should be considered. Second, if dependable isolation is not feasible, the cathodic member of the couple should be covered with a nonconducting protective coating. By reducing this area, or eliminating the cathode entirely, corrosion is correspondingly controlled in a safe manner. Under no circumstances should only the anode be painted. Any defect or holiday in the coating then will result in the entire cathodic area being coupled to a small area of. In the atmosphere, galvanic-couple corrosion is confined to a short distance, usually a fraction of an inch, from the joint between the two metals. Under immersed conditions, galvanic-couple corrosion may be significant for metals in electrical contact as much as, say, feet or more apart, such as between the bronze propeller and an exposed area on the steel hull of an oceangoing vessel. Some examples of galvanic couples and their corrosion behavior are given in Table 7.

Sheathcompacted powder, hot rolled, sheath removed, cold rolled in air. Crevice Attack Metal B.

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Chapter 8 : Sea Water Corrosion - PDF Free Download

Best is to put the water hose into the sea water strainer, or into a pail after removing the hose from the seacock and putting it into the pail too so the engine raw water pump can suck only the amount of water it wants.

A07 Microfiche A01 This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof. Environmental Protection Agency and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation of their use. Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled water are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay of its components require a concentrated and integrated attack on the problem. The Safe Drinking Water Act represents the first national commitment to provide safe drinking water to the public. The National Secondary Drinking Water Regulations deal with the aesthetic qualities of drinking water such as taste, odor, color, and appearance, which, if substandard, could deter public acceptance of potable water provided by public water systems. Corrosion in water supply distribution systems is a very significant concern because it not only affects the aesthetic quality of the water but also it has an economic impact and poses adverse health implications. Corrosion by-products containing materials such as lead and cadmium have been associated with serious risks to the health of consumers of drinking water. In addition, corrosion-related contaminants commonly include compounds such as zinc, iron, and copper, which adversely affect the aesthetic aspects of the water. This manual provides information about the causes and types of corrosion as well as practical guidance to water suppliers and operators of water treatment facilities for detecting and solving corrosion-related problems, Victor Kimm, Director Office of Drinking Water U. ESE of Gainesville, Florida. Patricia H, Markey was Project Engineer. During the preparation of the manual, invaluable technical review and input were received from several individuals and agencies. Appreciation is expressed to the Office of Drinking Water, U. Peter Lassovszky, Project Officer, for his direction and guidance through all stages of the writing. Each draft of the manual was reviewed by a Blue Ribbon Panel of experts selected for their expertise and knowledge in the field of corrosion of potable water distribution systems. Special acknowledgment is due the following individuals, who served on this panel: Appreciation is expressed to Dr. Sidney Sussman, Technical Director of Olin Water Services for supplying several of the example photographs throughout the manual and for his contribution to the inhibitor treatment material in Section 7, Mr. Jiterdra Saxena and Arthur Perler, Office of Drinking Water, provided a section on regulatory aspects associated with the use of inhibitors. Individuals deserving particular mention are Mr. Appreciation is also expressed to Dr. Cotruvo, Director, and Mr. The many types of corrosion and the types of materials with which the water comes in contact make the problem more complicated. Because all operators have not had the opportunity to gain more than a basic understanding of chemistry and engineering, there is little of these disciplines included in the document. The goal in writing the manual was to create a "how-to" guide that would contain additional information for those who want to study corrosion in more detail. Those sections, though, do help in understanding how and why corrosion occurs. Two toxic metals that occur in tap water, almost entirely because of corrosion, are lead and cadmium. Three other metals, usually present because of corrosion, cause

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staining of, fixtures, or metallic taste, or both. These are copper blue stains and metallic taste, iron red-brown stains and metallic taste, and zinc metallic taste. The corrosion products in the distribution system can also protect bacteria, yeasts, and other microorganisms. In a corroded environment, these organisms can reproduce and cause many problems such as bad tastes, odors, and slimes. Such organisms can also cause further corrosion themselves. Corrosion-caused problems that add to the cost of water include 1. Corrosion is one of the most important problems in the water utility industry. It can affect public health, public acceptance of a water supply, and the cost of providing safe water. Many times the problem is not given the attention it needs until expensive changes or repairs are required. Both the Primary and Secondary Regulations recognize that corrosion is a serious concern. However, the lack of a universal measurement or index for corrosivity has made it difficult to regulate. As a result, the August amendments to the NIPDWR issued by EPA concentrate on identifying both potentially corrosive waters and finding out what materials are in distribution systems. The amendments to the regulations require that 1. All community water supply systems collect and analyze samples for the following corrosion characteristics: The samples be taken at a representative point in the distribution system. Two samples are to be taken within 1 year from each treatment plant, using a surface water source to account for extremes in seasonal variations. One sample per plant is required for plants using groundwater sources. Community water supply systems identify whether the following construction materials are present in their distribution system, including service lines and home plumbing, and report their findings to the state: In addition, states may require the identification and reporting of other construction materials present in distribution systems that may contribute contaminants to the drinking water, such as f vinyl-lined A-C pipe and g coal tar-lined pipes and tanks. Corrosion is the deterioration of a substance or its properties due to a reaction with its environment. In the waterworks industry, the "substance" which deteriorates may be a metal pipe or fixture, the cement in a pipe lining, or an asbestos-cement A-C pipe. For internal corrosion, the "environment" of concern is water. A common question is, "What type of water causes corrosion? Also, the nature of the material with which the water comes in contact is important. For example, water corrosive to galvanized iron pipe may be relatively noncorrosive to copper pipe in the same system. An example of a physical action is the erosion or wearing away of a pipe elbow because of excess flow velocity in the pipe. An example of a chemical action is the oxidation or rusting of an iron pipe. Biological growths in a distribution system can also cause corrosion by providing a suitable environment in which physical and chemical actions can occur. The actual mechanisms of corrosion in a water distribution system are usually a complex and interrelated combination of these physical, chemical, and biological actions. Following is a discussion of the basic chemical reactions which cause corrosion in water distribution systems, for both metallic and nonmetallic pipes. Familiarity with these basic reactions will help users recognize and correct corrosion problems associated with water utilities. Electrochemical Corrosion of Metal Pipes Metals are generally most stable in their natural form. In most cases, this stable form is the same form in which they occur in native ores and from which they are extracted in processing. Iron ore, for instance, is essentially a form of iron oxide, as is rust from a corroded iron pipe. The primary cause of metallic corrosion is the tendency also called activity of a metal to return to its natural state. Some metals are more active than others and have a greater tendency to enter into solution as ions and to form various compounds. Such a listing is also called a "galvanic series," for reasons which are discussed below. When metals are chemically corroded in water, the mechanism involves some aspect of electrochemistry. When a metal goes into solution as an ion or reacts in water with another element to form a compound, electrons electricity will flow from certain areas of a metal surface to other areas through the metal. The term "anode" is used to describe that part of the metal surface that is corroded and from which electric current, as electrons, flows through the metal to the other electrode. The term "cathode" is used to describe the metal surface from which current, as ions, leaves the metal and returns to the anode through the solution. Thus, the circuit is completed. All water solutions will conduct a current. The anode and cathode areas may be located in different areas of the pipe, as shown in Fig. 3. The anode and cathode areas Table 3. Environmental Science and Engineering, Inc. Simplified anode and

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cathode reactions of iron in contact with water. Oxygen plays a major role in the internal corrosion of water distribution systems. Oxygen dissolved in water reacts with the initial corrosion reaction products at both the anodic and cathodic regions. Oxygen also reacts with the hydrogen gas evolved at the cathode to form water, thus allowing the initial anodic reaction to continue depolarization. The simplified equations that describe the role of oxygen in aiding iron corrosion are shown below. Similar equations could be shown for copper or other corroding metals. Equations 1 and 2 are for anodic reactions and Eq. A similar electrochemical reaction occurs when two dissimilar metals are in direct contact in a conducting solution. Such a connection is commonly called a "galvanic couple. In this case, the more active metal, iron, would corrode at the anode and give up electrons to the cathode. The net effect would be a slowing down or stopping of copper corrosion and an acceleration of iron corrosion where the metals are in contact. In addition, the farther apart the two dissimilar metals are in the galvanic series see Table 3. For example, a copper-to-zinc connection would be more likely to corrode than a copper-to-brass connection. Lead is a stable metal of relatively low solubility and is structurally resistant to corrosion. Thus, even low levels of lead corrosion may be of major concern. Metallic lead is frequently protected from corrosion by a thin layer of insoluble lead carbonates that forms on the surface of the metal. The solubility of metallic lead plumbosolvency is complicated and is related to the pH and the carbonate content alkalinity of the water. Consistent control of pH in the presence of sufficient alkalinity will generally minimize plumbosolvency in water distribution systems. Role of oxygen in iron corrosion. Note that areas A and B are located on the inner pipe surface. Corrosion of Cement Materials The corrosion of cement-lined pipe, concrete pipe, or A-C pipe is primarily a chemical reaction in which the cement is dissolved by water.

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This brass drain plug, installed in a seawater strainer, dezincified, and fell out when simply touched. Phosphor bronze is typically made up of % copper and % tin, with the addition of a small amount of phosphorous.

Turbine wheel with damaged blade 14 Roots type blowers 16 Roots type blower for G. Checking backlash of rotor gears 18 Scored blower lobes 18 Checking clearances of Roots type blower lobes 19 Shaft oil seals 20 Failed serrated shaft 21 Hamilton-Whitfield blower 21 Air intake manifold 22 Schematic drawing of an oil separator 23 Effect of a worn bearing on oil leakage 24 Flame primer as used on the G. Cross section of manifold metal 27 Formation of scale in water jacket 28 Improper installation of wet type muffler 29 Use of pipe bend to prevent backflow of water 29 Use of three-way proportioning valve to regulate water flow to muffler 30 Use of throttling valve to control flow of water to muffler 30 Dry type muffler 31 Force produced in exhaust piping by thermal expansion 32 Use of flexible expansion joint to absorb thermal expansion 32 Illustration of pressure drop in exhaust piping and muffler 33 Types of bends used in exhaust lines 33 Water trapped due to sagging of elbow 34 Exhaust stack showing evidence of corrosion 34 3- Revision of stack design to eliminate corrosion 34 4- 1. Schutte and Koerting gear pump 37 Tuthill reversible fuel pump 38 Packing clamps improperly tightened, cocked 39 Cover plate of pump shown in Figure , showing uneven wear of bushing 39 Vane type fuel oil pumps 40 Worn and damaged seal on G. Bosch fuel supply pumps with hand prime feature. Excello fuel transfer pump 41 Schematic diagram of Bosch supply pumps 41 Sectional views of Bosch type pumps: Pumping principle, one-plunger stroke 44 Metering principle 44 Types of plungers 44 5. Plunger rotating mechanism 45 Good and bad plungers 45 APF pump sight window 48 Typical Bosch spray nozzle 51 Sectional views of nozzles 51 Nozzle and nozzle holder 52 American Bosch nozzle tester in operation 53 Variations in nozzle holder connections and adjustments 54 Throttling type pintle nozzle 56 Good spray from throttling nozzles 56 Spray patterns from standard pintle nozzles 56 Types of General Motors injectors 59 Injection and metering principle 60 Injector test stand 60 Sealing surfaces 62 Type A Excello fuel injection pump 67 Excello fuel pump drive unit, hydraulic unit, and safety filter 68 Excello fuel injection nozzle 71 Exploded view of nozzle tip 72 Use of special tools to assemble and disassemble nozzle 73 Cummins fuel system 74 Cummins fuel injector 75 Worn and scored distributor disk and cover 76 4 Worn and eroded injector cup tip 79 New injector cup tip 79 Pressure regulating valve 79 Atlas fuel system 80 Spray valve and actuating mechanism 81 Cutaway view of fuel oil pump 84 Lapping the plunger and barrel 86 4 Lapping the discharge valve and seat 86 Square lapping the relief valve seat 86 Fuel injector 87 Cutaway view of fuel injector 88 Lapping the lower valve seat and stem 89 Sectional view of fuel injection nozzle 90 Recommended methods for elimination of pipe breakage at root of threads 91 Duplex system standard practice 93 Duplex fuel filter 93 Plugging filter for washing 94 Schematic drawing of a fuel system 95 Strainer elements 96 4- Tank sampling device for diesel fuel 97 5- 1. Elementary governor mechanisms 99 Governor control mechanism Pierce mechanical governor Operating principle of hydraulic governor Marquette hydraulic governor Woodward type SI governor 5- 8. Simple overspeed trip mechanism 6- 1 Use of the centrifugal pump to clean heat exchangers Use of hand pumps and plungers to clean heat exchangers Repairing a strut tube leak. Both ends of tube require scaling Zinc electrode, before and after use Line valves Distortion of valve seat due to excess threads on pipe. Damaged gate valve, caused by throttling Tubing splice Simplex lube oil strainer 6- Michiana lube oil filter 7- 1. Heat exchangers