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A Review Report on findings of Experimental Pressure Vessel for Deep Sea Investigation

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Abstract—

The failures and advancements of deep sea pressure vessels are the subject of this paper's analysis of many analysts' study. The analysis takes into account a variety of causes of vessel failure, including Excessive deformation, stress concentration at junctions, end meshing, strengthening, and other issues are brought on by inadequate support. The review paper shows growing interest in improvement. The goal of this investigation is to advance the pressure vessel by identifying the materials, those that will support it in bearing the effects of its environment, and its structural design. According to the standards established by ASME in the pressure vessel code, studies were conducted for deep sea pressure vessel configuration. The investigator has the discretion to select pertinent explanatory data to ensure the thickness of the vessel's supportable walls. The study and synthesis of various recent and old pressure vessel studies is presented in this publication.

Keywords—deep sea investigation, experimental vessel, hydrostatic pressure, composite material, deep sea conditions

I. INTRODUCTION

Experimental vessels are frequently used in situations when it is necessary to keep liquids at high pressure and high temperature. They play a crucial role in handling facilities, nuclear power reactors, oil refineries, and the synthetic industry. However, it is possible to comprehend how to employ a pressure vessel for deep sea research or deep sea experiments while studying this review paper. Numerous accidents brought on by pressure vessel failures resulted in fatalities as well as long-lasting effects on the surrounding environment. Deep sea vessels in particular need to be configured with a higher safety factor in mind. The structure must be finished in accordance with ASME guidelines and standards. There are various places in a vessel where stress could build up, or the vessel could burst or deformation in a location such end reinforcements, rivet holes, welding ends, or a highly stressed zone. Therefore, it is necessary to give this subject further thought. To conduct the research, many publications are reviewed.

II. LITERATURE REVIEW

According to author V. Singh et al. Objective of this paper is a significant exploration under deep

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sea water is to study the experimental performance of dark matter search. It is an experimental approach for determining the advantages and disadvantages of using remote ocean water in obscurity matter search. This paper is limited to gives the information about the experiment setup and its relevant data but does not provide information about the housing of experimental setup. Gaps identified as optimum design of vessel or housing for deep sea experiment can be find out by means of mathematical or analytical approach. [1]

According to author Nadège Bouchonneau et al. objective of this paper is to improve the modeling, complementary experimental tests should be realized in order to better evaluate the convection coefficients FE analysis and analytical model to determine the thermal properties of the syntactic foam for several test conditions of temperature and pressure. This analytical model's findings are determining the noticeable thermal properties of syntactic foam in compliance with manufacturer data executed on commercial insulated pipes under service circumstances inner temperature up to 95°C and hydrostatic pressure up to 300bar. Limitation of test restricted to be realized in order to better evaluate the convection coefficients only and gaps Identified This study not involves internal thermal conduction and the other consists internal thermal convection between the metallic surfaces and the internal air. [2]

According to author D.Choqueuse et al. objective of this paper is the primary concern, for deep-water applications, specific device permitting mechanical loading to be performed under hydrostatic compression loading, the selection of materials and their flow assurance. It is an experimental test to determine whether these materials with tough outer coatings of up to 10-15 cm are exposed to severe hydrostatic compression of up to 30 MPa, temperature gradients of 4°c at the outer surface to 150°c at the inner wall, and high bending and shear stresses during installation. The limitation of this study is that it studies shear loading and hydrostatic compression that used an altered fixture and test methods, as there are numerous optimize test benches that provide more conclusive results. [3]

According to author J.D. Garcia-Espinel et al. objective of this paper is to study of influence of sea water to define and determine the best composite materials for marine civil engineer applications and several factors in their mechanical properties such as safety factors accordingly to design and transversal strength analysis of underwater vehicle and water cycle is taken in account. Findings of this descriptive study is Polyester, vinyl-ester and epoxy glass composites and their seawater intake states that it is directly linked to tensile and flexural strength degradation in glass fiber composites. In terms of moisture achieves saturation level to tensile slope and the influence of vinyl-ester composites biodegradability is measured. Limitation is only the study of Polyester, vinyl-ester and epoxy glass composites and their seawater intake states. [4]

According to author Elsayed Fathallah et al. objective of this paper is to optimize design of a composite elliptical deep-submerged pressure hull under hydrostatic pressure in order to lower the buoyancy factor to perform this involves commercial finite element analysis software ANSYS. Findings of this descriptive as well as analytical study is the marginal buoyancy factor provides a valuable threshold for the submarine pressure hull design so as to accelerate the payload and to increase the performance with respect to controlling the submarine. The bottommost lamina of the elliptical composite submersible pressure hull should have the fibers oriented nearly in the circumferential direction. Limitation is to achieve high values of the material failure load because high material strength is important for deep-diving pressure hulls and gaps identified as various parameters are also essential for deep diving pressure hull modeling of water diffusion, water induced damage etc. [5]

According to author Dr. J.D. Stachiw et al. goal of paper ceramic external pressure housings for

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deep sea vehicles is to create the external pressure housings for under water vehicles strongly buoyant at the design depth by using a few materials such as carbon fiber reinforced plastic and glasses, ceramic that provide essential weight to strength ratio. Finding of descriptive analysis is titanium stiffeners bonded to the edges of adjoining cylinders serve as a joint and provide the required elastic stability at a significant weight saving. Cylinders with integral caps save weight and fabrication cost by eliminating one set of joints in a housing. Large ceramic pressure housings for 20,000 feet depth are achievable. It is completely a descriptive approach that extracted all the data and finding. [6]

According to author K. Breddermann et al. objective of this paper is to construct pressure enclosures that investigate the capabilities of additive manufacturing. These hemispheres are composed of titanium and ceramic and have a nominal outer diameter of 70 mm were built on 3D printer systems, evaluated, and tested in a pressure tank. Finding of this prototype testing is AM process predicted the dimensional accuracy and the surface finish achieved and to develop design criteria for reliable pressure housings which will suit the AM process. A special class of pressure housing with a higher weight-to-displacement ratio may be developed in the future. Limitation is the measurement technique is not rated to be able to hold an external pressure above 30 MPa and this paper identifies definitely gives the idea of prototype testing, that how can we obtain the dimensional accuracy and the surface finish achieved. [7]

According to author Manuel N Maligas et al. objective of this paper is the selection of materials for deep water application and its process is much more difficult and complicated when compared to the same procedure for land based operations. Finding of this descriptive study is detail of corrosion control, chemical injection, and system operation which will be in future be further simplified as a smart equipment. A high degree of reliability is needed from all subsea projects if they are to be profitable, high degree of quality control and assurance is needed to insure that the correct material is deployed and that it will work as expected. This paper covers the constrained approaches for material selection for subsea production applications and gaps is identifies in terms of detailed material on corrosion control, chemical injection, and system operation will be further complicated as smart equipment is deployed in the future. [8]

According to author Patricia Fryer et al. objective of this paper is the geological characteristics of the region, including seismic evidence for a tear in deep. The rolling back induced by this tear results in greater depths along the trench's southern end than over here across its length, finding of the descriptive with geographical background paper is the great depth of the southern Mariana Trench is a consequence of the unusual regional tectonics. The sub-ducting plate is likely torn at about 144°15’E and is more steeply dipping west of the tear. This fault results in detachments of the slab west of the tear, causing migration of the trench axis and this migration is generally in N-S elongation. Limitation here is only emphasizing on the unusual depth of the southern Mariana Trench and the two greatest depths, the Challenger Deep and the HMRG Deep and gaps identified in addition to the Southern Mariana trench, India will also have such oceanic location where deep sea experiment can be done. [9]

According to author Peter Davies et al. objective of this paper is to test thick and thin block cylinders under quasi static long term loading thermosetting and thermoplastic matrix composites to failures. Finding of the descriptive approach with experimental proof is in Europe with a large number of organizations which are collaborated for last 30 years. The development of composite containers for oceanographic applications down to 6000 m depth has enabled appreciable occurrence to be gained. Awareness of the existence of these results and the more detailed descriptions provided in the references, may help with other developments and avoid costly repetition. Limitation is carbon/epoxy

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cylinders is used as composite with implosion pressures of up to 600 bar, corresponding to 6000m depth and here only carbon epoxy composites have been used to test cylinders. [10] According to author Julian Geelhoed objective of this paper is to define and create an underwater habitat for long-term marine life research in the Great Barrier Reef. With the involvement of technological advancement and new materials the design drastically changed from simple boxes to into more complex aquarium tunnels. Finding of this descriptive study is after design the sphere and basic cigar shape of the submarine could be optimized with hydrodynamics as a result of the smart combination between the pressure hull and the ballast tanks. This paper is restricted to identify the factors which affect the underwater structure, only three material structures were used and analyzed steel, concrete and glass/acrylic glass and identifies that descriptive study dependent on only three materials. [11]

According to author Michael Pinto et al. objective of this paper is to characterize the effects of the thickness and location of the coating on the mechanics of collapse as well as local pressure fields, with the goal of mitigating the pressure pulse by some measuring instrument. Experimental test finding is to performed in a pressure vessel designed to provide constant hydrostatic pressure during collapse, capture the full-field deformation and various results were observed that proved that thick interior coatings importantly diminish the breakdown and lighten the initial wall-to-wall interaction to minimize the energy ejected in the pressure pulse.. The work restricted details about the collapse which is characterized using local measurements and identified gaps in terms of the performance properties of pressure vessel, during collapse could be done by using the standard measurement. [12]

According to author A. H. Tuthill et al. Objective of this paper are graphs and synopses of a huge backlog of reported data and experience for the preference of economical materials that sort reliable data and service that is long-lasting. Findings of data based descriptive study where overall data is presented that permits the designer to screen his initial material selection in terms of general wasting away, pitting, crevice effects, fouling, velocity effects and cavitations, galvanic effects, selective attack, stress corrosion cracking, deep immersion, and cost are used. This paper gives the relative information from the material selection that the material is right for deep sea water application. [13]

According to author Alex Kikeri Vaskov objective of this paper is to show technological innovations add up to make the deep-sea challenger a quick, maneuverable submarine that has the capability for immense data collection and scientific observation all while being a fraction of the size of the Trieste. Searching of descriptive study, it gives features of past vehicles that have reached the Challenger Deep including a variety of advanced systems and materials are used on Cameron's dive craft. Four important characteristics are identified in this paper namely: buoyancy materials, pilot sphere construction/instrument housings, lighting, and battery power early stages of development. Limitation of this paper gives an overview of many novel features of the Deep-sea Challenger. [14]

According to author A. Boisseau et al. objective of this paper is to evaluate the test programmed which is configured, to calculate and analyze the sustainability of composites for conversion of ocean energy systems. Finding of the experimental test study is to collects data on cyclic loading of large composite structures, from the wind turbine industry and the performance is also generally excellent. With the improvement in interaction between mechanical damage and seawater, there must be a result which improves design to guarantee long term performance of ocean energy conversion structures. It only focus on correct selection of fibers and resins for performance of composite materials in a marine environment and gap identifies as complete comparison of fiber and resin is missing here could expose the

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performance of composite material in a better manner. [15]

According to author Corentin Humeau et al. objective of this paper is to study a variety of materials (unreinforced resin, and three glass-fibre reinforced epoxy composites) to realize what governs the pressure effects on levels (1, 50 and 500 bar) and focuses on the determination of the diffusion law using a numerical method. This experimental test findings the lay-up composite showed significantly higher weight gain under high pressure whereas the resin weight gain was not affected by pressure. There were no effect for prepreg and a very small effect was observed on infused composites. Limitation is of the three different types of glass fiber reinforced resin immersed in water at different pressures up to 500 bar and gap identified in terms the weight gain by the resign is not completely described. [16]

According to author Zongshang Si et al. objective of this paper is the key issues and challenges in using the generalized KdV model (GKdV model for short) for continuous wave field of ISWS is acquired from the polarized ocean in the South China Sea.. Finding of mathematical model is the calculation is done for shear forces and torques exerted by ISWs on a supposed rigid pile, which results that the torque is largest at the pile foot and the shear force is largest at the turning point of the horizontal velocity induced by ISWs. Limitation is the numerical simulation results revealing the mechanism of destructive power exerted by large-amplitude ISWs on a pile and numerical simulation shows here what effects are happening on a pile. [17]

According to author Qiujuan Lv et al. objective of this paper is to demonstrate the pressure vessel detection involves acoustic emission technology, which also researches on high pressure cylinder detection and mechanical properties of materials. Finding of this experimental test is the difference of acoustic emission signal energy values between different gap tip radius and gap depth are compared and it is observed that acoustic emission energy increases with the decrease of the tip radius of the gap and increases with the gap depth. Here this test is based solely on experimental data and restricted to the analysis of the acoustic emission signal of fatigue damage process is carried out on the basis of experimental data. [18]

According to author Parth D. Pathak et al. objective of this paper is the methods to combine the two design methods of HPHT as per the guidelines of API 17 TR 12 and economically efficient and lightweight HPHT as per API 17 TR 8 and validate them. Findings of this descriptive study is on the basis of the plots defining the stress of the equipment, no stress increment was observed between the two cases, which states that the 15,000- psi will have same fatigue design life, even if the equipments are to be used for higher internal pressure as long as the differential pressure is less than or equal to 20,000psi. Limitation of these paper shows the applicable design methods only from API 17 TR 8, it is recommended, the different load cases to be analyzed and gap is Identified as design method has been applied only on API 17TR 12 and API 17 TR 8 recommendation. [19]

According to author Miguel Lamas-Pardo et al. objective of this paper is to review the conception of very large floating structures, to show how they are positioned on coastal areas and offshore. Their purpose of creating a floating harbors and airports and in consequence to logic development, with a wide variety of functions is reviewed. Findings of this descriptive article, different models are evaluated and compared, sorting their advantages and disadvantages according to the depth in which they work and on the basis of the proximity to the coast. In future for offshore developments two value points for very large floating structures will be “semi-submersible” and “concrete” and gap identified as conceptual blueprint for a semi-submersible structures made in concrete, for instance from the Aker maritime ASA , the hybrid structure is all different from all the other outlooks. [20]

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According to author Ozden O. Ochoa a et al. objective of this paper is to examine significant achievements and challenges in the design, fabrication, and testing of composite risers in order to demonstrate the seamless interdependence between constitutive behavior, structural response, optimization, simulation and inspection for offshore composite of deep-water concept. Findings of this experimental test is on the foundation of manufacturing, inspection, strength and "satisfaction" with the engineering solutions for the triad of the design the interest of optimization of the return in the advanced offshore composite depends. The ability of specific strength and stiffness, thermal conductivity, resistance to corrosive fluids, reduction in damping is properties are the novelty characteristics of this material system. Limitation of this experiment only limited to exhibit a simple, robust in-service honest monitoring system and restricted to the lack of economic consideration in offshore composite for vessel construction. [21]

According to author T. J. Glover objective of this paper is the basic problem of high fuel bills, maintenance costs and performance losses which are primarily concern to all boat and ship owners are solved by the use of cupronickel for hull construction. Finding of the descriptive study in terms of International Nickel Copper Organization, INCO provides all the information on material size, fabrication , their price and availability with this Considerable service experience also already exists to solve the problem of loss in performance, high fuel bills and maintenance by technically and economically with the use of cupronickel considerable. Limitation and Identification from this study, it only focus towards the construction of ships and boats by copper- nickel alloy in accordance with Copper Development Association, International Copper Research Association, INCO Europe Ltd. [22]

III. CONCLUSION

Examination of stresses, study of thermal and fatigue load conditions, and assessment of linear and nonlinear pressure forces are all included in the review of the literature. Researchers Investigations into pressure, materials, and synthesis are of particular importance because they all address the causes of vessel failures. As a result, it is found that no researchers focused on improving and optimizing vessels for deep sea experimentation. The impact of analysis and synthesis, which causes tensions in the shell, must be fundamentally investigated. The pressure fixation at the support ends and bore ends side is always influenced by the position. Support ends and fixation bores are positioned in a way that lessens the concentration of stress in a given area. Location of Support ends and fixation bores help to lesser the stress concentration at specific area. Due to these flaws, it is necessary to focus on improving or optimizing the area where vessel structures are synthesized and analyzed for use in undersea experiments. This is done by considering the location of the experiment, the desired material, and the design's ability to withstand the environment.

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