iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6223

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Identification and Control Measure for Nitrogen Narcosis in Underwater Welding

D. Aravindhan[1], Mr. J. Senthil Kumar[2]
[1]*ME-II[nd]year, Department of Industrial Safety Engineering,* [2]M. E., *Mechanical Engineering, Excel College of Engineering and Technology, Namakkal, Tamilnadu, India*

Abstract: Development of modern transportation system there are various types of ships are used to transport goods and peoples from one place to another place. In this process damaged ships are refurnished and welding process is takes place underwater because of the size and weight of the ship. Major safety concerns in underwater welding are electric shock, exploitation, drowning, hypothermia, nitrogen narcosis etc., the major hazard in the underwater welding process is nitrogen narcosis. It occurs majorly due to usage of oxygen cylinder while diving for the repair process. The occurrence of the nitrogen narcosis can be avoided by proper training to the welder and divers. And hands on training to handle the oxygen cylinders while diving. Proper calibration should do for all cylinders used for this kind of work. The gas filling process should do in a proper manner at proper condition. The air composition in the filling process should be in proper ratio to avoid accidents.
Keywords: Occupational Hazard, nitrogen narcosis, health, safety

I. INTRODUCTION

Welding is one of the most ancient and widely used hot work operations in shipbuilding process. The welding operation takes place in shipbuilding process is used to reduce the cycle time of the ship building process. Underwater welding is classified in to two major types dry welding and wet welding. The major difference between these welding processes is, dry welding is also known as "hyperbaric welding" a dry environment is carried out in chamber sealed around the structure to be welded. The chamber is filled with a gas (commonly helium containing 0.5 bar of oxygen) at the prevailing pressure. Whereas the wet welding process is carried out at ambient water pressure in which, the weld is exposed to the water. And also reduce steel weight and also requires less maintenance compare to rivet joints. The major contribution of welding technology to the shipbuilding industry is the possibility of producing smooth hull surfaces, therefore reducing the bare hull resistance and power requirements considerably. The welding joints are producing smooth hull surfaces, therefore reducing the bare hull resistance and power requirements considerably. Various kinds of hazard are occur during the underwater welding process in that the major hazard is nitrogen narcosis which may lead to fatigue accident and in sever condition it may lead to death. Nitrogen narcosis is also known as inert gas narcosis, raptures of the deep. Generally it occurs due to anaesthetic effect of certain gases at high pressure. It can occur during shallow dives, but does not usually become noticeable at depths less than 30 meters (100 ft).

II. METHODOLOGY

Nitrogen narcosis is induced due to breathing high partial pressures or concentrations of nitrogen while underwater. While diving breathing air in the cylinder with nitrogen, this condition is caused when the diver goes deeper into the water, where the partial pressure of nitrogen increases and more nitrogen ends up getting absorbed into the bloodstream. When high level of nitrogen concentration in the blood stream, slower the nervous system will experience intoxicating effects that can seriously impair their judgment underwater which may lead them into dangerous situations. The common air mixture for diving purpose are 21% oxygen, 78% nitrogen and approximately 1% other trace gases, primarily argon. In this mixture the major portion is contain nitrogen due to this the possibility of nitrogen narcosis occurrence is high. Nitrogen is a common normally colourless, odourless, tasteless and mostly diatomic non-metal gas. Nitrogen constitutes 78 percent of Earth's atmosphere and is a constituent of all living tissues. Nitrogen is an essential element for life, because it is a constituent of DNA and, as such, is part of the genetic code. Health effects caused by nitrogen or nitrates are react with haemoglobin in blood, causing the oxygen carrying capacity of the blood to decrease, decreased functioning of the thyroid gland. The major symptoms of nitrogen narcosis are discussed in detail.

A. Lightheadedness.

It happens due to decreased blood flow to the brain. The drop in blood pressure makes feel faint. Light-headedness often occurs while moving quickly deeper into the water level. Without enough fluids, the volume of your blood goes down, lowering your blood pressure and blood flow to brain reduced it may lead to light-headedness.

B. Tinnitus.

Tinnitus is the perception of noise or ringing in the ears. Tinnitus usually isn't a sign of something serious. It involves the sensation of hearing sound when no external sound is present. The symptoms may include these types of phantom noises in your ears:

Ringing	Clicking
Buzzing	Hissing
Roaring	Humming

The phantom noise may vary in pitch from a low roar to a high squeal, and you may hear it in one or both ears. In some cases, the sound can be so loud it can interfere with your ability to concentrate or hear external sound.

C. Hallucination.

Generally it causes due to change in brain activity. It could be a mental illness called schizophrenia, a nervous system problem like Parkinson's disease, epilepsy, or of a number of other things.

D. Ataxia

Ataxia is also known as coordination impairment or loss of coordination. Ataxia occurs when there is a interception in communication between the brain and the rest of the body. It causes jerky and unsteady movements in body.

III.NITROGEN NARCOSIS MECHANISM

On the surface we breathing air that contains different gases, like oxygen, nitrogen and carbon dioxide. Our body consumes oxygen and expel carbon dioxide. But some gases we inhale but those are not required for body function like nitrogen. So they not make any effect on the body, so they are known as “inert gases” But in the underwater surface they have more of an effect, due to the increased pressure. Because when we dive the force of the water increases the pressure of the gases we breathe. When we dive deeper, all the gases are filled in smaller cylinders and are more concentrated. Our body carry gases to various organs and tissues that need oxygen. The nervous system controls all the body systems and senses.

If a person goes below 100 feet sea water, nitrogen will start to have an effect on the brain due to the laws of partial pressure. Nitrogen is a type of inert gas, its effects on the brain causes a depressed mental state. The deeper a diver goes, the greater the narcosis. The compressed air in the tank is delivered to the diver through a regulator, which reduces the pressure from the tank to match the ambient pressure. At the surface, ambient pressure is 1 atm and it increases by 1 atm for every 10 m in depth through which a diver descends. Nitrogen, a major constituent of air, is quite inert and passes into the fluids and tissues of the body without undergoing chemical change. Nitrogen is absorbed by the fatty tissue (lipids) much faster than by other tissues; the brain and the rest of the nervous system have a high lipid level content. Each individual has his own threshold of susceptibility; some divers experience narcosis at 15 m, while others can go to 60 m without any apparent effects. Most often, nitrogen narcosis begins to be apparent at about 10 m of depth. As a diver goes deeper, the symptoms increase in severity. Other inert gasses associated with narcosis include neon, argon, krypton, and xenon, with the latter having an anaesthetic effect even at sea level.

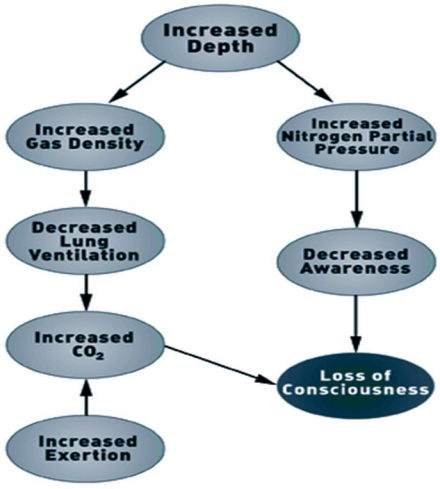

Fig.1. Nitrogen Narcosis Mechanism

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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IV. RISK ASSESSMENT

Risk assessment process is to evaluate hazards, then remove that hazard or minimize the level of its risk by adding control measures as necessary. In this underwater welding process nitrogen narcosis is induced due to the air breath during diving. We must follow the gas law while filling the cylinders.

A. Boyle's Law

At constant temperature, the volume of a gas varies inversely with the pressure, while the density of a gas various directly with pressure. P1V1 = P2V2 = Constant

The law becomes particularly important on deep dives; it predicts that the inhaled air will become denser the deeper one goes, As a result of increasing air density, deep divers often notice greater difficulty breathing.

B. Charles's Law

At a constant volume, the pressure of gas varies directly with absolute temperature. The law is useful to keep in mind when there is a large difference between air and water temperatures.

C. Dalton's Law

The total pressure exerted by a mixture of gases is equal to the sum of the pressures that would be exerted by each of the gases if it alone were present and occupied the total volume

Pt = P1+P2….Pn

Where,

Pt – Total pressure of gas mixture

P1, P2 – Pressure of component gases (e.g., oxygen and nitrogen)

D. Henry's Law

The amount of any gas that will dissolve in a liquid at a given temperature is a function of the partial pressure of the gas in contact with the liquid and the solubility coefficient of the gas in that particular liquid. Amount of nitrogen dissolved in plasma depends on depth and duration. Rate of nitrogen pressure equilibration depends on the affinity of the tissue for nitrogen and the rate of blood flow to that tissue.

V. PROBLEM IDENTIFICATION

Nitrogen narcosis is induced due to inhale compressed air from an oxygen cylinder while under a lot of pressure from water, if increases the pressure of oxygen and nitrogen in blood. This increased pressure affects central nervous system. Except for helium and probably neon , all gases that can be breathed have a narcosis effect, although widely varying in degree. The effect is consistently greater for gases with higher lipid solubility. As depth increases, the mental impairment may become hazardous. Due to its perception altering effects, the onset of narcosis may be hard to recognize. They also resembles the effects of alcohol or cannabis and the familiar benzodiazepine drugs such as diazepam and alprazolam. The breathing gas mix entering the diver's lungs will have the same pressure as the surrounding water, known as the ambient pressure. After any change of depth, the pressure of gases in the blood passing through the brain catches up with ambient pressure within a minute or two, which results in a delayed narcotic effect after descending to a new depth. Rapid compression potentiates narcosis owing to carbon dioxide retention. Returning at less high pressure the gas it's not yet soluble and it turns in the volatile form, remaining in the brain.

VI. CONCLUSIONS

The most straightforward way to avoid nitrogen narcosis is for a diver to limit the depth of dives. Since narcosis becomes more severe as depth increases, a diver keeping to shallower depths can avoid serious narcosis. Further training is normally required for certification up to 30 m (100 ft) on air, and this training should include a discussion of narcosis, its effects, and cure. Strongly encourage the use of other breathing gas mixes containing helium in place of some or all of the nitrogen in air because helium has no narcotic potential. The use of these gases forms part of technical diving and requires further training and certification. To avoid narcosis involves early recognition of symptoms by the diver or the diver's partner while at depth. Symptoms resolve completely within minutes upon ascent of the diver. If the symptoms persist, the dive should be aborted. Exhale thoroughly may expel more carbon dioxide, which seems to accelerate the onset of narcosis. The instruments used while diving should calibrated properly and during diving all equipments should monitor properly in constant intervals. Avoid hard handling the regulators and valves in the equipment.

VII. ACKNOWLEDGMENT

The satisfaction that the one gets on completion of a task cannot be fully enjoyed without mentioning the people who made it possible. I am very much grateful to the almighty, who helped us all the way and who moulded me into what I am today. I am remaining indebted to my parents who have sacrificed many things for my success. I submit my heartfelt regards and sincere thanks to them.

I express my sincere thanks and I gratitude to my honourable Chairman, Prof. Dr A.K.NATESAN, M.Com. MBA., M.Phil., Ph.D.,FTA, PHF for all the help he have provided in accomplishing this task.

I convey my kind regards and thanks to my beloved Principal, Dr.R.NALLUSAMY, M.E., Ph.D., who motivated me to take up this project work for having provided the suitable environment to work with.

I express my sense of gratitude and sincere thanks to the Head of the Department Dr.S.P.VENKATESAN, M.E., Ph.D., of mechanical engineering for his valuable guidance in the preparation and presentation of this paper work.

I express my profound sense of thanks with deepest respect and gratitude to my supervisor Mr. J.Senthil Kumar, M.E., Associate professor, Department of Mechanical Engineering for his valuable and precious guidance throughout the period of work.

My sincere thanks are due to my Friends, Teaching, Non-Teaching Staff members and the well-wishers for their constant support all the time.

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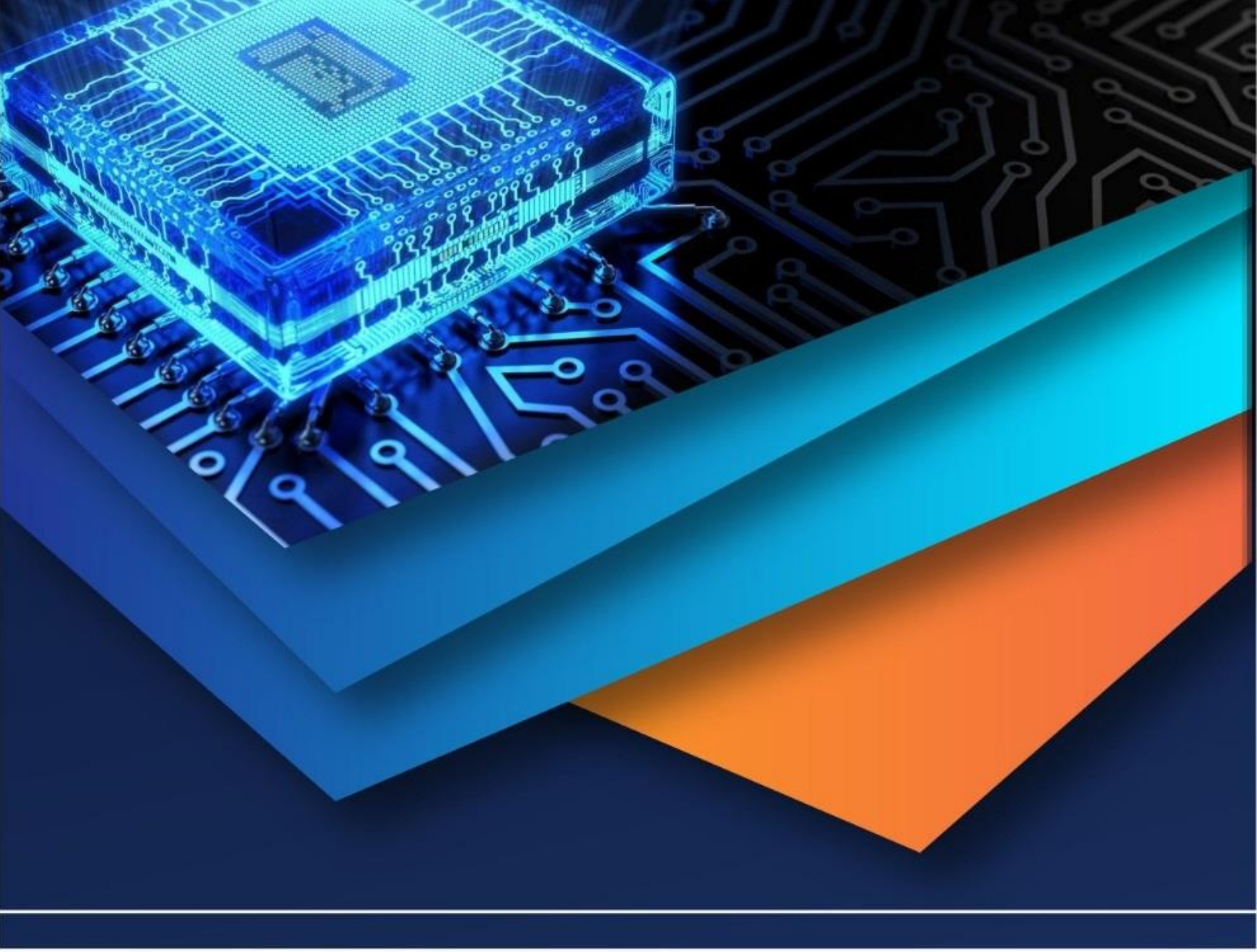

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