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# EFFECTS OF DIESEL-OIL SPILLAGE OF FRESH, BRACKISH AND MARINE WATERS ON POLYVINYL-ALCOHOL (PVA) SYNTHETIC FISHING TWINE

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## ABSTRACT

The effects of diesel-oil spillage of fresh (0.4ppt), brackish (25ppt) and marine (37ppt) waters on elongation (cm) and breaking load (kgf) of artisanal PVA synthetic twine of varied diameters (4mm, 6mm, 8mm and 10mm) soaked for 16 weeks was studied. Chemical (solubility) test was carried out to identify the experimental twine as PVA among others synthetic twines. The elongation (cm) and breaking load (kgf) of PVA twine diameters were tested by tensile-strength gauge machine (0-200kg) and was carried out in unpolluted (control) and polluted states (spillage level) at 0%, 20%, 40%, 60%, 80% and 100% diesel-oil concentrations of different water salinity. Factorial statistics was used to analyze the treatments, twine (at four levels), water salinity (at three levels) and concentrations (at six levels). This implies 4 by 3 by 6, replicated in four places (288 treatments). Results indicated that elongation (cm) and breaking load (kg) of the specimens were significantly ($P<0.05$) influenced by twine thickness. Twine 10mm soaked in 3.0litres of unpolluted freshwater had significant ($p<0.05$) correlation coefficient r, 0.927 and lowest r-value of 0.499 was obtained in twine 4mm soaked in 100% diesel-oil concentration. Significant ($P<0.05$) relationships were observed between the correlation coefficient r = 0.531-0.927 for unpolluted and r=0.499-0.592 for polluted tests. The study revealed that diesel-oil spillage had negative effects on the quality of twines. The thicker the PVA twine diameters (10, 8, 6 and 4mm) at lowered (0%, 20%, 40%, 60%, 80% & 100%) diesel-oil spillage of fresh (0.4ppt), brackish (25ppt) and marine (37ppt) waters respectively, the higher the significant ($P<0.05$) elongation (cm) and breaking load (kgf) were evaluated in most cases.

**Keywords: Diesel-oil spillage, PVA synthetic fishing twine, Fresh water, Brackish water and Marine water.**

## INTRODUCTION

The Nigerian oil sector can be categorized into three main sub-sectors, namely, upstream, downstream and gas (Oil and Gas Business, 2008). The most problematic over the years has been the downstream sector, which is the distribution arm and connection with final consumers of refined petroleum products in the domestic economy. The incessant crisis in supply of products culminated in the decision by the government in 2003, to deregulate the downstream sub-sector. However, the manner of its implementation has been controversial, because it ignores the economic realities in Nigeria (Oil and Gas Business, 2008). Crude oil discovery has had certain impacts on the Nigeria economy both positively and adversely (Oil and Gas Business, 2008). On the negative side, this can be considered with respect to the surrounding communities within which the oil wells are exploited. Some of these communities still suffer environmental degradation, which leads to deprivation of many livelihood and other economic and social factors. Crude oil interferes with the chemical communication of the water bodies and even when oil loses its chemical toxicity as a result of weathering, other hazards remain which may be manifested by the imposition of high biological oxygen demand due to auto-oxidation, physical contamination and accumulation of oil by sea foods, and physical interference with fishing and recreation (Dublin - Green *et al.*, 1997). Oil exploration and exploitation activity in Nigeria has been associated with frequent oil spills, especially through equipment failure, rupture of pipelines, engineering error and vandalization (Ajao, 1996). Diesel-oil is one of the products of crude oil that is refined at the refinery and separated into light and heavy fractions which are further converted into various products (Oil and Gas Business, 2008). Other products are petrol, jet fuel, kerosene, lubricants, waxes, and asphalts. Diesel-oil spillage has a serious economic impact on the aquatic environment and on the equipment and material used in fishing (fishing twine or gear and crafts). In most cases, such damages are temporary and caused primarily by the physical properties of oil in creating nuisance and hazardous condition. Oil spillage into water bodies is capable of increase microbial activities which will rapidly de-oxygenate the affected water bodies, downstream from the point of oil discharge, hence resulting in an oxygen-sag curve. The extent of de-oxygenation depends on a number of factors including the dilution of the crude oil or effluent on entering the water body and the amount of biologically oxidizable materials in the crude oil of the effluent (water neutrophication). Also, the fishing gears are sometimes depreciated in quality and swimmers are likely to be exposed to high irritation problems as a result of diesel-oil spillage (F10 Laws of the Federation, 2002).

## MATERIALS AND METHODS

This research was conducted in a simulated Fishery laboratory at the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Ogun state, South West Nigeria. Identification of the experimental white synthetic twine by solubility test was achieved, this test was necessary to know the chemical group which the twine belongs as the marketers always muddle-up the seven different types of synthetic twines for profit interest. The safety precaution common for chemical laboratories, such as putting the twine sample in the reagent and not pouring the reagent on twine sample to avoid explosion was observed. These materials were used for solubility test; heat source from bunsen burner, 2 forceps, 5 glass test tubes of 10ml each, 5 pieces of 30cm experimental synthetic white twine, and five different reagents. Each test tube contained 30cm experimental synthetic white twines mixed separately with each of these five different reagents; Hydrochloric acid; Sulphuric acid; Dimethylformamide; Formic acid and Glacier acetic acid. The two forceps were used to hold the test tube firmly into the flame and the 5 test tubes were heated simultaneously with the aid of lighted bunsen burner to discover its solubility rate (Klust, 1973). The reaction of experimental white twine with different reagents after heating was noticed and recorded. The experiment was four by three by six (4 x 3 x 6) factorial experiment. That is, twine sizes replicated at four levels (4, 6, 8 &10mm), water salinity replicated at three levels (0.4, 25 & 37 parts per thousand) and diesel-oil concentrations replicated at six levels (0, 20, 40, 60, 80 & 100% by volume).

Twenty five (25) litres of diesel-oil was purchased at Dambold filling station, camp, Alabata area, Abeokuta, Ogun State. Marine and brackish water samples were collected from bar-beach and Lagos lagoon respectively, both in Lagos State, while fresh water was collected from Oyan Lake in Ogun State using 20 litres keg. Salinity of the three water bodies was measured with water salinity chemical test kit of model HI3835. Artisanal PVA synthetic fishing twine of diameters 4, 6, 8 and 10mm were bought at Adeniji Adele market in Lagos State. 70cm of 72 pieces each, of diameters 4, 6, 8 and 10mm were cut and knotted at both ends to prevent loosening. All treatments added up to two hundred and eighty-eight (288). The well-labeled eighteen experimental bowls of 4 litres capacity were labeled and arranged in three groups of fresh, brackish and marine water samples at 0%, 20%, 40%, 60%, 80% and 100% concentration levels. Diesel-oil spillage samples of fresh, brackish and marine waters were then prepared artificially using measuring cylinder (cl). Zero percent (0%) diesel-oil spillage of fresh water contained 3litres of non-polluted fresh water (control). 20% diesel-oil spillage concentration of fresh water contained 0.6litre of diesel-oil in 2.4litres of fresh water (0.6/2.4litres). 40% diesel-oil concentration of fresh water contained a mixture of 1.2litre of diesel-oil in 1.8litres of fresh water (1. 2/1.8litres) and so on. Thus, sixteen twine pieces (4 replicates, each of 4, 6, 8 and 10mm) were immersed in each of the eighteen experimental bowls that contained diesel-oil spillage of fresh, brackish and marine water samples at 0%, 20%, 40%, 60%, 80% and 100% concentration levels and were left for duration of 16 weeks. The 288 netting twines were brought out of the eighteen experimental bowls after 16 weeks immersion and were tested using the method described by Klust (1982).Elongation (cm) and breaking-load (kgf) effects of these 288 artisanal PVA synthetic twines were then measured in fishing gear laboratory of Nigeria Institute for Oceanography and Marine Research (NIOMR), Lagos state. Each test specimen was fastened between the two clamps of a tensile testing machine. The test samples were stretched by an increasing load until it broke. The elongation (cm) and breaking load (kgf) were measured and calculated. Breaking load is the maximum load (force) needed for the material to break. The samples were fastened to the clamp of the machine and extended under increasing force until they break and the point at which it breaks was recorded as breaking load value in kilograms-force (kgf). In the International System of Units, SI, it is expressed in Newton (N). 1kgf = 9.80665N. Elongation is the increase in length of a specimen during a tensile test, expressed in units of length, e.g. millimeters or centimeters. Permanent (or irreversible) elongation is the part of the total increase in length which remains after the removal of stress. (Klust, 1973;1982). Elongation (cm) = Final length (cm) - Original length (cm)

## STATISTICAL ANALYSIS

Factorial statistics was used to analyze the data. Data collected were subjected to analysis of variance. Significant means were separated using Least Significant Difference (LSD) at 95% confidence value ($P < 0.05$). Correlation and Regression analysis were used to distinguish relatively between elongation (cm) and breaking load (kgf) of the twine tests (Klust, 1982).

## RESULTS AND DISCUSSION

The experimental synthetic white twine was chemically identified by solubility test as PVA (Table 1). About 10ml each of these five reagents; Hydrochloric acid; Sulphuric acid; Dimethylformamide; Formic acid and Glacier acetic acid which were mixed separately with experimental twine in different five glass test tubes that were heated with the aid of lighted bunsen burner reacted differently. The twine was observed soluble in hydrochloric acid, sulphuric acid and formic acid which correlate with its attributes as discovered by (Klust, 1973). Whereas, the twine was not soluble in dimethylformade formamide boiled for 5minutes and was decomposed by exposure to light even when stored in a brown bottle. It is therefore advised to store away from light and preferably in a cool place. Glacier acetic acid boiled for 5minutes was not also soluble, Table 1. And all these soluble reaction confirms the experimental white twine to be PVA which agrees with the findings of Klust (1973; 1982).

Table 1; Chemical (Solubility Test) Identification of PVA Synthetic Twine

| Reagents/ Methods | Solubility rate |
|---|---|
| Hydrochloric acid/ HCL (37%) + twine for 30 minutes at room temperature | + |
| Sulphuric acid/ $H_2SO_4$ (98%)− twine for 30 minutes at room temperature | − |
| Dimethylformide/HCON$(CH_3)_2$+twine boiled for5minutes | 0 |
| Formicacid/HCOOH(97%)+ twine for 30minutes at roomtemperature | + |
| Glacier acetic acid/CH3-COOH−twine boiledfor5minutes | 0 |

Key; + signifies soluble and 0 signifies not soluble

Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Fresh water (0.4ppt): Table 2 showed elongation (cm) and breaking load (kgf) of PVA twine diameters immersed in diesel-oil concentration of fresh water (0.4ppt). PVA netting yarns reacted differently during immersion in waters. Some lengthened in diesel-oil pollution and some remained unchanged in unpolluted waters and in accordance with (Klust, 1982), the influence of water on the mesh size is in principle, the same as on length of netting yarns. Further still, it was observed during the experiment set-up in a laboratory that polluted waters of fresh, brackish and marine waters at varied diesel oil concentrations maintained their quantity as compared to non-polluted waters which evaporated very rapidly. Elongation correlated positively and highly significantly difference ($p<0.05$) with breaking load. The correlation coefficient r-values ranging from 0.542-0.927 for diesel-oil polluted and unpolluted fresh water twine samples. Twine 10mm soaked in 0% diesel-oil concentration of fresh water had the highest correlation coefficient ($r=0.927$), which implies that Y is significantly different from X at 93% probability level. That is, the closer the correlation coefficient r to 1.00, the stronger and more durable the elongation and breaking load (kgf) of PVA twine diameters were analyzed.

Table 2; Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Fresh water (0.4ppt)

| Conc level (%) | PVA Dia (mm) | Prediction Equation (Y) | Correlation Coefficient (r) | Coefficient of Determination ($r^2$) | Significant Levels (5%) |
|---|---|---|---|---|---|
| 0 | 4 | $6.66X^2$-47.83X+ 363 | 0.684 | 0.468 | S |
| | 6 | $7.07X^2$-9.076X+1.00 | 0.787 | 0.619 | S |
| | 8 | $8X^2$-270X+ 243.111 | 0.890 | 0.792 | S |
| | 10 | $17.79X^2$-13X+ 855 | 0.927 | 0.859 | S |
| 20 | 4 | $4.42X^2$-145.6X+ 342 | 0.580 | 0.336 | S |
| | 6 | $4.97X^2$-41.00X+ 312 | 0.585 | 0.342 | S |
| | 8 | $6.42X^2$-212.1X+ 500 | 0.588 | 0.346 | S |
| | 10 | $7.301X^2$-34.43X+ 881 | 0.589 | 0.347 | S |
| 40 | 4 | $3.5X^2$-30X+ 1234 | 0.577 | 0.333 | S |
| | 6 | $4.595X^2$-59.46X+ 44.6 | 0.581 | 0.338 | S |
| | 8 | $5.821X^2$-1308X+ 11.0 | 0.583 | 0.339 | S |
| | 10 | $6.935X^2$-111X+ 76.00 | 0.586 | 0.343 | S |
| 60 | 4 | $2.075X^2$-0.300X+ 15.13 | 0.563 | 0.317 | S |
| | 6 | $3.275X^2$-0087X+ 78.31 | 0.569 | 0.324 | S |
| | 8 | $3.575X^2$-87.24X+ 33.01 | 0.571 | 0.326 | S |
| | 10 | $4.200X^2$-051.31X+76.22 | 0.576 | 0.332 | S |
| 80 | 4 | $1.995X^2$-223X+ 35.21 | 0.554 | 0.307 | S |
| | 6 | $2.148X^2$-106X+ 14.09 | 0.561 | 0.315 | S |
| | 8 | $2.635X^2$-139X+ 22.22 | 0.563 | 0.317 | S |
| | 10 | $3.101X^2$-49.1X+ 05.06 | 0.567 | 0.321 | S |
| 100 | 4 | $0.968X^2$-1.398X+ 213 | 0.542 | 0.294 | S |
| | 6 | $1.241X^2$-0543X+ 439 | 0.551 | 0.304 | S |
| | 8 | $1.031X^2$-1111X+ 534 | 0.556 | 0.309 | S |
| | 10 | $2.50X^2$-30.36X+ 129 | 0.559 | 0.312 | S |

Source: Field Survey, 2010

Note: S is significant ($p<0.05$) at 95% confidence value

Twine 8mm at 0% diesel-oil concentration of fresh water had the corresponding r-value of 0.890, followed by twine 6mm soaked in 0% diesel-oil concentration of fresh water($r=0.787$), 4mm soaked in 0% diesel-oil concentration of fresh water(r=0.684), 10mm in 20% diesel-oil concentration of fresh water (r=0.589), 8mm in 20% diesel-oil concentration (r=0.588 ), 10mm soaked in 40% diesel-oil concentration of fresh water (r 0.586), 6mm soaked in 20% diesel-oil concentration of fresh water(r=0.585) and so on. Whereas, 4mm of 100% diesel-oil concentration had the least correlation coefficient r - 0.542, meaning that Y is significantly different from X at 54% probability level, that is, the farther the correlation coefficient r-value to 1.00, the lower and weaker the elongation (cm) and breaking load (kgf) of PVA twine diameters were observed (Table 2).

Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Brackish water (25ppt) Elongation (cm) and breaking load (kgf) of PVA twine diameters immersed in varied diesel-oil concentration of brackish water were evaluated in Table 3. Elongation correlated positively and highly significantly difference ($p<0.05$) with breaking load. The correlation coefficient r-values ranging from 0.531-0.560 for twine samples soaked in diesel-oil polluted and unpolluted brackish water. Twine 10mm soaked in 0% diesel-oil concentration of brackish water had the highest correlation coefficient r of 0.560, which implies that Y is significantly different from X at 56% probability level. That is, the closer the correlation coefficient r to 1.00, the stronger and more durable the elongation and breaking load (kgf) of PVA twine diameters were analyzed. Twine 8mm at 0% diesel-oil concentration of brackish water had the corresponding r-value of 0.557, followed by twine 6mm soaked in 0% diesel-oil concentration of brackish water (r=0.555), 4mm soaked in 0% diesel-oil concentration of brackish water(r=0.551), 10mm in 20% diesel-oil concentration of brackish water (r=0.550), 8mm in 20% diesel-oil concentration (r=0.548 ), 6mm soaked in 20% diesel-oil concentration of brackish water (r=0.547), 10mm soaked in 40% diesel-oil concentration of brackish water (r=0.546), 8mm soaked in 40% and 4mm soaked in 20% diesel-oil concentration of brackish water were not significantly different ($p>0.05$), r=0.543.

Table 3; Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Brackish water (25ppt)

| Conc level (%) | PVA Dia (mm) | Prediction Equation (Y) | Correlation Coefficient (r) | Coefficient of Determination ($r^2$) | Significant Levels (5%) |
|---|---|---|---|---|---|
| 0 | 4 | $0.986X^2$-31.98X+ 298.4 | 0.551 | 0.304 | S |
| | 6 | $1.125X^2$-4038.8X+ 366.1 | 0.555 | 0.301 | S |
| | 8 | $9.091X^2$-353X- 3448.7 | 0.557 | 0.310 | S |
| | 10 | $11.79X^2$-518.6X+ 5534 | 0.560 | 0.314 | S |
| 20 | 4 | $3.42X^2$-115.6X+ 1015 | 0.543 | 0.295 | S |
| | 6 | $2.287X^2$-76.55X+ 683 | 0.547 | 0.299 | S |
| | 8 | $4.42X^2$-504.1X+ 4458 | 0.548 | 0.300 | S |
| | 10 | $6.66X^2$-61.43X+ 5764 | 0.550 | 0.303 | S |
| 40 | 4 | $1.565X^2$-53X+ 488.8 | 0.541 | 0.293 | S |
| | 6 | $1.595X^2$-59.36X+ 44.6 | 0.543 | 0.295 | S |
| | 8 | $1.821X^2$-116X+ 11.06 | 0.544 | 0.296 | S |
| | 10 | $1.995X^2$-406X+ 76.00 | 0.546 | 0.298 | S |
| 60 | 4 | $1.075X^2$-00.36X+ 15.13 | 0.532 | 0.283 | S |
| | 6 | $1.275X^2$-0086X+ 78.02 | 0.536 | 0.287 | S |
| | 8 | $1.575X^2$-11.36X+ 33.21 | 0.539 | 0.291 | S |
| | 10 | $1.732X^2$-09.36X+ 76.22 | 0.541 | 0.293 | S |
| 80 | 4 | $0.995X^2$-223X+ 47.10 | 0.533 | 0.284 | S |
| | 6 | $0.119X^2$-106X+ 76.13 | 0.535 | 0.286 | S |
| | 8 | $1.005X^2$-133X+ 78.43 | 0.537 | 0.288 | S |
| | 10 | $1.521X^2$-30.7X+ 82.00 | 0.538 | 0.289 | S |
| 100 | 4 | $0.004X^2$-1436X+ 213 | 0.531 | 0.282 | S |
| | 6 | $0.241X^2$-11.36X+ 439 | 0.533 | 0.284 | S |
| | 8 | $0.711X^2$-11.36X+ 534 | 0.534 | 0.285 | S |
| | 10 | $0.975X^2$-11.36X+ 129 | 0.536 | 0.287 | S |

Source: Field Survey, 2010

Note: S is significant ($p<0.05$) at 95% confidence value

Also, twine 4mm of 80% diesel-oil concentration of brackish water and twine 6mm of 100% diesel-oil concentration were not significantly different ($p>0.05$), r=0.533 and so on. Whereas, 4mm of 100% diesel-oil had the least correlation coefficient r =0.531, meaning that Y is significantly different from X at 53% probability level, that is, the farther the correlation coefficient r-value to 1.00, the lower and weaker the elongation (cm) and breaking load (kgf) of PVA twine diameters were observed (Table 3).Although, synthetic materials are generally strong, but this study revealed that 10mm of PVA synthetic twine which had the highest thickness among other experimental twines such as 8,6 and 4mm exhibited the highest elongation and breaking load in most cases. This could lead to increase mesh sizes of fishing nets constructed from such twines, which is in line with (Klust, 1982), that the elongation of netting yarns naturally increased with increasing thickness. In other words, the heavier the netting yarns, the more force equally be tainted. And also that the change of colour of the fishing gears constructed from PVA netting twines could cause reduction in the number of fish to be caught, as the fishes will avoid the nets when they sight it. This is in agreement with Kristjonsson et al., (1968), who reported from his observation on the catches and interviews with fishermen that owned different colours of monofilament gill nets, "that white net catches relative more fish than the coloured nets simply because the colour of the nets resemble that of water where fish live". Kristjonsson et al., (1968) attributed the high catches to the low visibility of the white nets in water. In addition, the quality of the fish caught with diesel-polluted net is likely to be of low quality and may even have residual toxins in the fish caught, if such nets are used.

The diesel-oil spillage could directly damage the fishing gears (made of PVA twine) used for catching aquatic species. The oil companies should pay commensurate compensation to fisher folks whose sources of income are adversely affected by oil spills in those aquatic systems where they fish. Loan facilities should be made available to the fishers especially through the agricultural cooperative and rural development banks, at a government subsidized interest rates. This will encourage the fishers into harvesting increased amount of fish in a friendly, unpolluted water bodies. There is need for legislation against all forms of obnoxious fishing methods such as the use of chemicals in fishing and there is also need to emphasize the law enforcement agents. Also, the R-tex twine used in constructing individual fishing nets should be considered and incorporated in the final estimation of compensation, as it affects individual fisherman. Industrial activities, especially exploration and production of oils should be carried out in an environmentally friendly manner with a view to cause little or no damage to aquatic equipments and resources, and where damage occurs, it must be remediated as soon as possible and adequate compensation paid accordingly (Anene et al., 2010).

Finally, the formation of the National Oil Spill Detection and Response Agency (NOSDRA) by the Federal Executive Council of Nigeria should be emphasized. The putting in place of relevant acts and regulations on oil spill pollution and passing into law of the Niger Delta Development Commission (NDDC) are necessary. The establishment of the Niger Delta Environmental Survey, incorporating oil trajectory and fate models into oil spill management policy in the country will be appreciated. Also, the development of standards for the environmental sensitivity index maps for the coast of Niger

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(load) is required to obtain elongation. It was also observed that PVA twine of different diameters soaked in polluted and unpolluted water bodies differed significantly ($p<0.05$) in some cases with slight insignificances in other cases. Thus, this observation disagree with Brandt (1959), who reported that the test with netting materials made of polyvinyl alcohol, polyamide and polyester showed no significance in breaking load whether soaked in the distilled, fresh, brackish or marine waters.

Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Marine water (37ppt) Table 4 shows positive correlation with high significantly difference ($p<0.05$) of elongation (cm) and breaking load (kgf). The correlation coefficient r-values ranging from 0.499-0.536 for twine samples soaked in diesel-oil polluted and unpolluted marine waters. Twine 10mm soaked in 0% diesel-oil concentration of marine water had the highest correlation coefficient r of 0.536, which implies that Y is significantly different from X at 54% probability level. And the closer the correlation coefficient r to 1.00, the stronger and more durable the elongation (cm) and breaking load (kgf) of PVA twine diameters were analyzed. Twine 8mm at 0% diesel-oil concentration of marine water had the corresponding r-value of 0.535, followed by twine 10mm soaked in 20% diesel-oil concentration of marine water($r=0.533$), twine 6mm soaked in 0% diesel-oil concentration of marine water($r=0.532$), 4mm soaked in 0% diesel-oil concentration of marine water($r=0.531$).Meanwhile, 8mm in 20% diesel-oil concentration of marine water had no significant difference ($p>0.05$) with 10mm of 40% diesel-oil concentration ($r=0.530$). 6mm of 60% diesel-oil concentration of marine water had no significant difference ($p>0.05$) with 10mm of 1000% diesel-oil concentration ($r=0.515$). Also, 4mm of 80% diesel-oil concentration of marine water had no significant difference ($p>0.05$) with 8mm of 100% diesel-oil concentration ($r=0.513$). Thus, twine 4mm soaked in 100% diesel-oil concentration had the least correlation coefficient $r=0.499$, meaning that Y is significantly different from X at 50% probability level, that is, the farther the correlation coefficient r-value to 1.00, the lower and weaker the elongation (cm) and breaking load (kgf) of PVA twine diameters were observed in diesel-oil polluted waters (Table 4).

Table 4; Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Diesel-oil Polluted Marine water (37ppt)

| Conc level (%) | PVA Dia (mm) | Prediction Equation (Y) | Correlation Coefficient (r) | Coefficient of Determination ($r^2$) | Significant Levels (5%) |
|---|---|---|---|---|---|
| 0 | 4 | $0.621X^2-11.01X+831.0$ | 0.531 | 0.282 | S |
| | 6 | $0.833X^2-878.4X+318.1$ | 0.532 | 0.283 | S |
| | 8 | $5.032X^2-398X+311.4$ | 0.535 | 0.285 | S |
| | 10 | $7.73X^2-276X-352$ | 0.536 | 0.287 | S |
| 20 | 4 | $2.21X^2-1034 6X+5321$ | 0.527 | 0.278 | S |
| | 6 | $2.687X^2-76.55X+683$ | 0.529 | 0.279 | S |
| | 8 | $2.92X^2-524.1X+098$ | 0.530 | 0.281 | S |
| | 10 | $4.300X^2-657.0X+321$ | 0.533 | 0.284 | S |
| 40 | 4 | $1.334X^2-3X+431.08$ | 0.523 | 0.274 | S |
| | 6 | $1.311X^2-59.36X+06.8$ | 0.526 | 0.277 | S |
| | 8 | $1.621X^2-116X+0106$ | 0.528 | 0.279 | S |
| | 10 | $2.795X^2-406X+76.00$ | 0.530 | 0.281 | S |
| 60 | 4 | $0.005X^2-00.36X+28.30$ | 0.511 | 0.261 | S |
| | 6 | $0.222X^2-0086X+39.64$ | 0.515 | 0.265 | S |
| | 8 | $0.532X^2-11.36X+345.4$ | 0.516 | 0.266 | S |
| | 10 | $1.462X^2-04536X+7617$ | 0.520 | 0.270 | S |
| 80 | 4 | $0.001X^2-003X+98.02$ | 0.513 | 0.263 | S |
| | 6 | $0.201X^2-108X+84.43$ | 0.514 | 0.264 | S |
| | 8 | $1.105X^2-223X+09.22$ | 0.517 | 0.267 | S |
| | 10 | $1.521X^2-00.79X+31.00$ | 0.518 | 0.268 | S |
| 100 | 4 | $0.001X^2-1436X+093$ | 0.499 | 0.249 | S |
| | 6 | $0.11X^2-11.36X+880$ | 0.510 | 0.260 | S |
| | 8 | $0.621X^2-11.36X+435$ | 0.513 | 0.263 | S |
| | 10 | $0.785X^2-11.36X-269$ | 0.515 | 0.265 | S |

Source: Field Survey, 2010

Note: S is significant ($p<0.05$) at 95% confidence value

## CONCLUSIONS

The artisanal polyvinyl alcohol (PVA) fishing twine immersed in unpolluted and varied diesel-oil pollution of fresh, brackish and marine waters was studied. The breaking load (kgf) and elongation (cm) of PVA twines were found to be influenced by the R-tex. Diesel-oil spillages have a serious economic impact on the fishing twine. It was observed that PVA twines soaked in three different water samples of varied diesel-oil concentration were tainted by the oil product, and took up a brownish colour instead of the formal colourless nature of water before pollution. This alteration in colour showed that hanging ropes of artisanal fishing nets used to fish in polluted water bodies will