Assessment of Mechanical Strength Properties on Automotive Gas-Oil (AGO) Polluted Artisanal PVA Synthetic Fishing Twine.

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ABSTRACT

PVA synthetic twine diameters 4mm, 6mm, 8mm and 10mm were immersed in unpolluted and polluted states of 0%, 20%, 40%, 60%, 80% and 100% AGO concentration of Oyan-lake (0.4ppt), Lagos-lagoon (25ppt) and Sea (37ppt) waters. Tensile strengths (kgf/mm) of 288 treatments were tested with tensile-strength gauge machine (0-200kg) after 16-weeks immersion. Results indicated that tensile strength of the specimens were significantly ($P<0.05$) influenced by twine thickness. Analysis of variance (ANOVA) showed that R-Tex twine sizes were significant between the test specimens of unpolluted and polluted states. Tensile strength was highest in twine 10mm (mean 131.75±2.5) soaked in 0% AGO of freshwater, lower in 4mm (mean 34.48±4.5) soaked in 80% AGO concentration of marine and lowest in twine 4mm (mean 30.00±3.1) soaked in 100% AGO. The thicker the PVA twine diameters at lowered AGO spillage of fresh, brackish and marine waters respectively, the higher the significant tensile strength value was evaluated.

(Keywords: mechanical strength, automotive gas-oil, AGO, PVA synthetic fishing twine, fishing gear, Oyan Lake, Lagos Lagoon, seawater,)

INTRODUCTION

According to Brandt, (1975), as new materials become available, new problems will arise and new test methods will have to be developed to measure properties of synthetic materials not yet developed. For instance, the effect of crude oil pollution in our water bodies and its effect on the biological organisms in various water bodies has been the subject of numerous investigations. However, little or no studies have been done on improvement of synthetic twines in Nigeria. Polyvinyl Alcohol (PVA) fibers, the production of which is based on the research of Hermann and Heahnel (1931), have been greatly improved in Japan since 1938. However, Brandt (1975), emphasized that the precision which is other desirable in the textile industry cannot be achieved and or even may not be required with the raw materials often used for making fishing nets. Therefore, 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. Abdulsalami *et al., (2012*), confirmed that those properties of netting materials and netting are usually of interest only in the wet condition. The usual dry strength test used in the textile industry are normally valueless to fishery and even be dangerous when they lead to an incorrect decision.

Oil being the mainstay of the Nigerian economy plays a vital role in shaping the economic and political destiny of the country. Automotive gas oil (AGO) spillage has a serious economic impact on the aquatic environment and on the equipment and material use 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. 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 fishery sector in Nigeria is divided into three main parts, which are marine water ecosystem (sea), brackish water ecosystem (lagoon, estuaries) and freshwater ecosystem (rivers, lakes). Longhurst (1964) discovered that the Nigerian marine fisheries ecosystem covers about 960 km coastline. The exclusive economic zone was created in 1978 and goes about 320 km into the water.

Bar-beach is enclosed with marine water that is one of the many beaches scattered along Lagos coastline.

Oyan Lake is a major tributary to the West of Ogun River. It is located 07^0 58'N and 03° 02'E with a catchments area of $1610km^2$ (Ikenweiwe *et al.,* 2007). This lake covers an area of 4000 hectares, with a catchments area of approximately 9000 square kilometers, within the southern climatic belt of Nigeria.

Lagos lagoon is the largest complex of all the four lagoon systems of the gulf of guinea coast in West Africa. (Solarin *et al.,*1979). The main body of this Lagos lagoon system lies between longitude -3022 and 3040- east and latitude -6017 and 6028-north. It has a small tidal range of between 0.3 - 1.3 m and a shallow water depth of between 0.3 m and 3.2 m.

Tensile test is a test use to measure the resistance of a material to the force tending to stretch the specimen in only one direction. Tensile Strength refers to the maximum (breaking) tensile stress (force) per unit cross-sectional area of the unstrained specimen, commonly expressed in kilogram-force per square millimeter (kgf/mm).

MATERIALS AND METHODS

Four different sizes of artisanal PVA fishing twines of diameters 4mm, 6mm, 8mm and 10mm were bought at Adeniji Adele market in Lagos State. Twenty five (25) litres of automotive gas oil was purchased at *Dambold* filling station, camp, Alabata area, Abeokuta, Ogun State. Sea (marine) water and lagoon (brackish) water samples were collected from bar-beach and Lagos lagoon respectively, both in Lagos State, while Oyan lake (fresh) water was collected from *Oyan* Lake in Ogun State. 20 liters keg was used for the collection of each water body and their salinity was measured with water salinity chemical test kit of model HI3835 and recorded.

The experimental white synthetic twine was identified by burning test, that 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. Burning test was performed in an air-tight laboratory and the following materials were used; a clean flame from a Bunsen burner**,** two-forceps to hold the twine materials firmly to the flame, experimental synthetic twine and matches to lighten the Bunsen burner. Two forceps were held with both hands and were used to pick up the already cut 200cm long synthetic twine. The untwisted 200cm synthetic twine was then introduced to the flame of the lighted Bunsen burner and the reaction of netting material near the flame and after removal from the flame as regard burning, shrinkage, melting, change of color, and crushable were noticed and recorded. Also, the smell of the gaseous products (smoke) and the residue were perceived and recorded (Klust, 1973; Griffin, 2011).

Well-labelled eighteen (18) experimental bowls (4 liters capacity) were used and arranged in three groups, (6 bowls/groups) in a simulated fishery's laboratory of UNAAB in July, 2010. Each group of six (6) experimental bowls contained varied AGO concentrations of marine, brackish and fresh waters. 70cm of 72 pieces each, of diameter 4, 6, 8 and 10mm were cut and knotted, only at both ends to prevent loosening. All samples summing up to a total of two hundred and eighty-eight (288).

Experimental polluted waters were prepared artificially with measuring cylinder (cl), Zero percent (0%) concentration level; contained 3 liters of non-polluted marine water (control). 20% concentration level; contained 0.6 liter of automotive gas oil in 2.4 liters of marine water (0.6/2.4 liters). 40% concentration level; contained a mixture of 1.2 liter of oil in 1.8 liters of marine water (1.2/1.8 liters). 60% concentration level; contained a mixture of 1.8 liters of oil in 1.2 liters of marine water (1.8/1.2 liters). 80% concentration level; contained a mixture of 2.4 liters of oil in 0.6 liter of marine water (2.4/0.6 liters). 100% concentration level; contained 3 liters of oil without marine water. Thus, that same procedure was used to prepare the AGO polluted water samples of brackish and fresh.

Each of the 18 experimental bowls contained sixteen test pieces, 4 replicate each of diameter

4, 6, 8, and 10mm which were soaked in polluted waters for 16 weeks duration. The treatments, twine (at four levels), water salinity (at three levels) and concentrations (at six levels) were analyzed with factorial statistics. This implies 4 by 3 by 6, replicated in four places (288 treatments). The 288 PVA netting twines specimens were then brought out of the three different polluted waters, after 16 weeks immersion and were tested for tensile strength (kgf/mm) as described by Klust (1982). In accordance with Klust (1973), each test specimen was then fastened between the two clamps of a tensile testing machine (0-200kg) and extended under increasing force until it broke. In the International System of Units, SI, tensile strength (kgf/mm) is expressed in Newton (N). 1kgf = 9.80665N. From the experimental data, the tensile strength (kgf/mm) were examined and calculated.

Data was subjected to analysis of variance (ANOVA) and means separated using Least Significant Difference (LSD) and Pearson Correlation Test, to determine the percentage difference (kilogram force per square millimeter). Also, t-test was used to compare the means of tensile strength (kgf/mm) between the observed values and the standard values of the twine sizes (Klust Gehard, 1983).

RESULTS and DISCUSSION

Oyan-lake, Lagos lagoon and Sea waters tested with salinity chemical test kit of model HI3835 had 0.4ppt, 25ppt and 37 parts per thousand (ppt) respectively (http://www.wikipedia.org). Table 1 shows the result obtained for chemical (burning) test identification of PVA synthetic twine. PVA synthetic twine was considered been thermoplastic in nature. It curled, shrunk, burnt in light flame. The melting substance drips from the flame, mostly a hard brown to black, irregular residue and non-crushable. The smoke of the burnt twine perceived was sharp chocking smell like chlorine and signified experimental twine to be PVA (Klust, 1973; Griffin, 2011). Although the smell may be changed by agents attached to the netting materials.

Effects of varied automotive gas-oil concentration on tensile strength (kgf/mm) of different diameters of PVA twine.

Table 2 revealed that PVA twine of diameter 10mm soaked in unpolluted water, had the highest significant ($p< 0.05$) tensile strength (108.92^{b}) followed by twine 8mm ($67.05^{c}\pm1.20$) soaked in unpolluted water and twine 10mm ($91.67^{c}\pm1.40$) soaked in 20% automotive gas-oil concentration which were not significantly different in their tensile strength (kgf/mm). Also, twine 4mm ($40.53^{e}\pm1.45$) in unpolluted water, 6mm ($44.50^{e}\pm1.10$) in 20% automotive gas-oil concentration and 8mm ($47.92^{e}\pm1.06$) in 60% automotive gas-oil concentration were not significantly ($p< 0.05$) different in their tensile strength (kgf/mm) effects. Twine 6mm ($41.00^{f}\pm1.44$) soaked in 40% automotive gas-oil concentration and 10mm ($74.67^{f}\pm1.03$) in 80% were not also significantly different in their tensile strength (kgf/mm). Thus, twine 8mm ($45.33^{ef}\pm1.08$) soaked in 80% automotive gas-oil concentration and 10mm ($81.00^{ef}\pm1.00$) in 60% had no significant tensile strength (kgf/mm) values.

Table 1: Chemical (Burning Test) Identification of PVA Synthetic Twine

Test Reactions	Features
Twine in flame	Shrunk, melted, curled and burnt very rapidly with light flame and yellowish melting dripped down
Twine removed from the flame	It continued to burn rapidly and melted bead substance could not be stretched
Residue of the burnt twine	Hard, brown to black, irregular, non-crushable
Smell of the smoke	Sharp chocking smell like chlorine

Source: Field survey, 2010

Table 2: Effects of Varied Automotive Gas-Oil (AGO) Concentrations on Tensile Strength (kgf/mm) of Different Diameters of PVA Twine.

Twine Diameters (mm)	0% Conc.	20% Conc.	40% Conc.	60% Conc.	80% Conc.	100% Conc.
4	$40.53^{e}\pm1.45$	$39.28^{fg}\pm1.05$	$36.92^{h}\pm1.30$	$35.67^{hi}\pm1.00$	$32.67^{i}\pm1.10$	$29.73^{j}\pm1.30$
6	$46.08^{d}\pm1.35$	$44.50^{e}\pm1.10$	$41.00^{f}\pm1.44$	$39.52^{g}\pm1.00$	$36.67^{h}\pm1.11$	$33.50^{i}\pm1.09$
8	$67.05^{c}\pm1.20$	$58.88^{cd}\pm1.15$	$54.00^{de}\pm1.25$	$47.92^{e}\pm1.06$	$45.33^{ef}\pm1.08$	$39.50^{g}\pm107$
10	$108.92^{b}\pm1.50$	$91.67^{c}\pm1.40$	$86.00^{cd}\pm1.35$	$81.00^{ef}\pm1.00$	$74.67^{f}\pm1.03$	$71.80^{g}\pm1.01$

Hint; b-j are ANOVA superscripts. Means (Figures) with the same letters (superscripts) have no significant difference at 5% probability (P>0.05)

Meanwhile, twine 8mm ($39.50^{g}\pm107$) and 10mm ($71.80^{g}\pm1.01$) soaked in 100% automotive gas-oil concentration were not significantly different in their tensile strength (kgf/mm). The tensile strength (kgf/mm) of twine 4mm ($36.92^{h}\pm1.30$) in 40% automotive gas-oil concentration and 6mm in 80% automotive gas-oil concentration were not significantly different from each other. Twine 4mm ($32.67^{i}\pm1.10$) soaked in 80% automotive gas-oil concentration and 6mm ($33.50^{i}\pm1.09$) in 100% were not significantly different in their tensile strength (kgf/mm), whereas, twine 4mm ($29.73^{j}\pm1.30$) in 100% automotive gas-oil concentration had the corresponding least tensile strength (kgf/mm) values (Table 2).

The aforementioned therefore revealed that PVA fibres with high denier per filament were found to be more resistance than PVA fibers with low denier per filament. That is, the thicker the PVA twine, the less noticeable the photo-degradation was during testing. Tensile strength (kgf/mm) was significantly highest (p>0.05) in twine diameter 10mm compared to other twine diameters at all concentration level of diesel followed by twine 8mm, 6mm and significantly lowest on twine 4mm as revealed above.

The bigger the PVA twine diameters at lowered automotive gas-oil pollution, the higher the tensile strength (kgf/mm) effect was observed, which implies that high durability of fishing gears could be constructed from bigger diameter (10mm) of PVA twine when not used in polluted waters. Thus, sustainability of fish production by the artisanal fishermen in this country could be hindered through-oil pollution that had a very high negative effect on tensile strength (kgf/mm) of the artisanal PVA fishing twine, from which various fishing gears are constructed (Table 2)

Water types at varied concentration of automotive gas oil pollution had significant effects on tensile strength (kgf/mm) of PVA twine. Twines soaked in polluted freshwater at varied automotive gas-oil concentrations were significantly (p>0.05) higher in tensile strength (kgf/mm) than twines soaked in the same automotive gas oil concentration of polluted brackish and marine waters respectively. Twines soaked in varied automotive gas oil concentration of brackish and marine waters were not significantly (p>0.05) different in tensile strength (kgf/mm) in most cases. PVA twine soaked in unpolluted (0%) fresh water had the highest significant (p> 0.05) tensile strength ($76.69^{b}\pm2.00$), followed by twine ($66.47^{c}\pm2.05$) soaked in 20% automotive gas oil concentration of the same fresh water and the twine ($61.15^{cd}\pm2.10$) soaked in unpolluted (100%) brackish water.

The tensile strength (kgf/mm) of the twines soaked in 60% fresh ($60.38^{d}\pm2.01$), 20% brackish ($56.25^{d}\pm2.01$) and 0% marine ($58.85^{d}\pm2.06$) were not significantly different. Twine ($55.50^{fg}\pm2.11$) soaked in 80% automotive gas-oil concentration of fresh water and that of 40% automotive gas-oil concentration of marine were not significantly (p>0.05) different in their tensile strength (kgf/mm). Also, the PVA twine ($40.53^{e}\pm1.45$) soaked in unpolluted (100%) water, 6mm ($44.50^{e}\pm1.10$) in 20% automotive gas-oil concentration and 8mm ($47.92^{e}\pm1.06$) in 60% automotive gas-oil concentration were not significantly (p> 0.05) different from one another in their tensile strength (kgf/mm). Twine 6mm ($41.00^{f}\pm1.44$) soaked in 40% automotive gas-oil concentration and 10mm ($74.67^{f}\pm1.03$) in 80% were not significantly different in their tensile strength (kgf/mm).

Table 3: Effects of Automotive Gas-Oil Polluted Waters of Fresh, Brackish and Marine on Tensile Strength (kgf/mm) of PVA Twine.

Water Types	0% Conc.	20% Conc.	40% Conc.	60% Conc.	80% Conc.	100% Conc.
F	$76.69^{b}\pm2.00$	$66.47^{c}\pm2.05$	$61.97^{cd}\pm2.12$	$60.38^{d}\pm2.01$	$55.50^{fg}\pm2.11$	$49.25^{i}\pm2.08$
B	$61.15^{cd}\pm2.10$	$56.25^{d}\pm2.01$	$51.25^{de}\pm2.13$	$46.25^{ef}\pm2.15$	$44.00^{gh}\pm2.12$	$41.20^{hi}\pm2.00$
M	$58.85^{d}\pm2.06$	$53.03^{de}\pm2.11$	$50.25^{fg}\pm2.03$	$45.45^{h}\pm2.07$	$42.50^{i}\pm2.04$	$40.05^{i}\pm2.02$

Hint; F, B & M mean Fresh, Brackish and Marine waters respectively
b-i are ANOVA superscripts. Means (Figures) with the same letters (superscripts) have no significant difference at 5% probability (P>0.05)

Thus, twine 8mm ($45.33^{ef}\pm1.08$) soaked in 80% automotive gas-oil concentration and 10mm ($81.00^{ef}\pm1.00$) in 60% were not significantly (p>0.05) different in their tensile strength (kgf/mm) effects. Twines soaked in 100% automotive gas oil concentration was observed to be relatively low in tensile strength (kgf/mm) value. Thus, this signifies the lower the automotive gas oil concentration in fresh (with lowest salinity content of 0-1ppt), brackish (with higher salinity content of 1-35ppt) and marine (with highest salinity content of above 35ppt) waters respectively, the higher the tensile strength (kgf/mm) observed in the study (Table 3).

Figure 1 shows the result of the significant effects of tensile strength (kgf/mm) on PVA twine diameters soaked in different water types at varied automotive gas oil (AGO) concentration. Tensile strength (kgf/mm) was significantly (p>0.05) highest in twine 10mm (with a mean of 131.75±2.50) soaked in 0% automotive gas oil concentration of fresh water and lowest in twine 4mm (with a mean of 30.00±3.10) soaked in 100% of automotive gas oil. Twine 4mm soaked in 0% automotive gas oil concentration of fresh water, 6mm of 40% automotive gas oil concentration of fresh water, 6mm of 20% automotive gas oil concentration of brackish water and 6mm of 0% automotive gas oil concentration of marine water were not differed significantly (p>0.05) in tensile strength (kgf/mm). Twine 6mm soaked in 0% automotive gas oil concentration of fresh water, 10mm soaked in 20% and 40% automotive gas oil concentration of fresh water and 10mm in 0% automotive gas concentration of marine water were not differed significantly (p>0.05) in tensile strength (kgf/mm) values.

Twine 4mm at 20% automotive gas concentration of fresh water, 6mm at 40% diesel oil concentration of fresh water, 8mm at 80% automotive gas oil concentration of fresh water and 4 & 6mm at 0% automotive gas oil concentration of marine water had equal tensile strength (kgf/mm) effects. Also, 6mm at 20% automotive gas oil concentration of fresh water and 8mm at 40 & 60% automotive gas oil concentration of fresh water had equal (p>0.05) tensile strength (kgf/mm) effects. Twine 4 & 6mm at 60% automotive gas oil concentration of fresh water were not differed significantly (p>0.05) in tensile strength (kgf/mm) values. Likewise, twine 4mm at 40 & 60% automotive gas oil concentration of fresh water were not significantly (p> 0.05) different in tensile strength (kgf/mm). Twine 6mm of 80% automotive gas oil concentration of fresh water, 6 & 8mm of 40% automotive gas oil concentration of brackish, 8mm of 60% automotive gas oil concentration of brackish water, 10mm of 80% automotive gas oil concentration of brackish water and 8mm of 20, 40 & 60% automotive gas concentration of marine waters were not significantly (p>0.05) different in tensile strength (kgf/mm) effects.

In addition, twine 8mm soaked in 100% automotive gas oil and 4mm soaked in 20% automotive gas oil concentration of fresh water were equal (p>0.05) in tensile strength effects. Twine 6mm at 80% automotive gas concentration of fresh water, 6mm of 40% automotive gas oil concentration of brackish water and 8mm of 60% automotive gas oil concentration of brackish water were significantly (p>0.05) not different in their tensile strength (kgf/mm) effects.

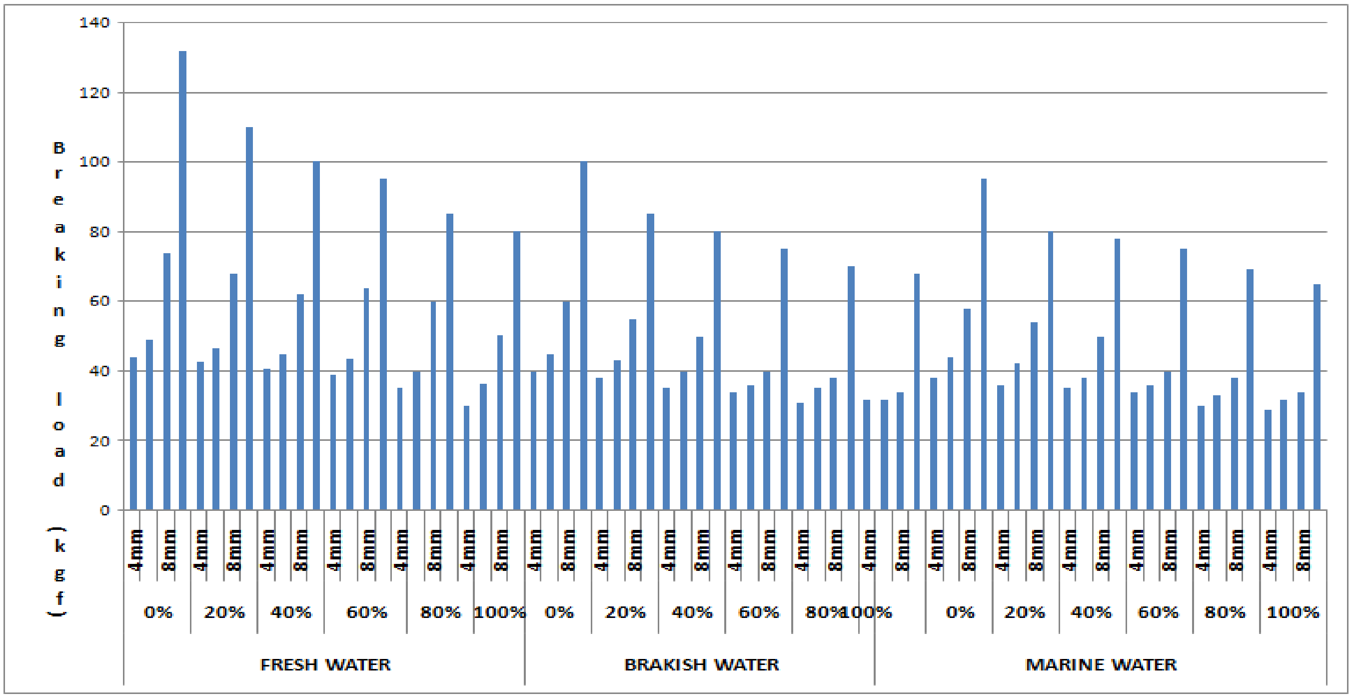

Figure 1: Effects of Different Water Types at varied Automotive Gas Oil Concentration on Tensile Strength (kgf/mm) of PVA Twine Diameters. Source: Field Survey, 2010

Twine 10mm soaked in 80% automotive gas oil concentration of fresh water and 10mm soaked in 20% automotive gas concentration of brackish water were not differed significantly in tensile strength at probability greater than five percent (p>0.05). Again, 10mm soaked in 80% automotive gas oil concentration of fresh water and twine 10mm at 40% automotive gas oil concentration of brackish water were significantly (p>0.05) not different in tensile strength (kgf/mm). Twine 8mm at 40% automotive gas oil concentration of brackish water and twine 6mm soaked in 20% automotive gas oil concentration of marine water were equal (p>0.05) in tensile strength values. Also, 4mm at 20% automotive gas oil concentration of brackish water and twine 8mm at 80% automotive gas oil concentration of brackish water were not significantly different (p>0.05) in tensile strength (kgf/mm).

Moreover, tensile strength (kgf/mm) of twine 4mm at 60% automotive gas concentration of brackish water and 8mm at 80% automotive gas concentration of the same brackish water were not significantly different (p>0.05) in tensile strength. Twine 10mm at 60% automotive gas concentration of brackish and marine waters were not significantly different (p>0.05) in their tensile strength. Twine 6mm at 80% automotive gas oil concentration of brackish water and 4mm at 20% automotive gas concentration of marine water had no significant (p>0.05) tensile effect. Twine 4mm at 0% automotive gas concentration of marine water and 6mm at 40% automotive gas concentration of marine water had equal tensile strength effects. Twine 4mm at 40% automotive gas concentration of marine water and 6mm at 60% automotive gas concentration of marine water had equal (p>0.05) tensile strength effects. Twine 4mm at 60% automotive gas concentration of marine water was not significantly (p>0.05) different from twine 8mm at 100% automotive gas concentration.

It was observed in most cases that, the thicker the twine diameters (10,8,6 & 4mm) at lowered automotive gas oil concentration (0,20,40,60,80 &100%) of fresh, brackish and marine waters respectively, the more the durability of the tensile strength (kgf/mm) of PVA twine as illustrated below (Figure 1).

The correlation of tensile strength (kgf/mm) of PVA twine diameters in unpolluted water types was calculated. The different PVA twine thickness correlated positively and highly significantly with tensile strength (kgf/mm), with r ranging from (r= 0.577- 0.933) for unpolluted test. The twine 4mm soaked in marine water had the least r-value =0.577), meaning that Y is significantly different from X at 58% probability level, that is, the farther the correlation coefficient r, to 1.00, the weaker and less durable the tensile strength (kgf/mm) of PVA twine diameters was observed in unpolluted waters. Twine 4mm soaked in fresh water (r=0.586) had the corresponding weaker effects on the tensile strength (kgf/mm) of experimental PVA twine, followed by 6mm of marine water (r=0.593), 8mm of marine water (r=0.624), 8mm of brackish water (r=0.664), 10mm of marine water (r=0.666), 4mm soaked in fresh water (r=0.699), 10mm of brackish water(r=0.700), 6mm of fresh water (r=0.800), 8mm of fresh water (r=0.929) whereas, twine 10mm soaked in fresh water had the highest correlation coefficient (r=0.933), which implies that Y is significantly different from X at 93% probability level, that is, the closer the correlation coefficient(r) to1.00, the more durable and stronger the tensile strength (kgf/mm) of PVA twine diameters observed in unpolluted waters (Table 4).

It is implied from the present study that the synthetic fishing twine in flame (burning test) was observed shrunk, curled and burnt very rapidly, synthetic fishing gears made from PVA twine in particular, are therefore not to come in contact with hot surfaces such as flame, high intensity of sunlight and should not be stored close to lighted stoves, radiators, open or in the tropics, under a corrugated iron roof which is exposed to solar radiation but are better air-dried.

Since marine water (37ppt) ecosystem was more prone to negative effects of automotive gas-oil concentrations (0%, 20%, 40%, 60%, 80% & 100% respectively) than brackish (25ppt) and fresh (0.4) waters respectively, which directly affected the tensile strength (kgf/mm) of the experimental PVA twine thickness (4, 6, 8 & 10mm respectively) from which different fishing gears of capture fishery could be constructed, it is therefore suggested that automotive gas-oil polluted water bodies should be adequately treated before fishing activities is embarked on, and that fishermen fishing in AGO polluted water bodies should be adequately compensated and not merely given generalized compensation. There is also need for legislation against all forms of obnoxious fishing methods such as the use of chemicals in capture fishery. There is also need to emphasis that law enforcement agents ensure the enforcement of such laws. Industrial activities (especially, exploration and production of automotive gas oil) should be carried out in an environmentally friendly manner with a view of causing little or no damage to the aquatic resources and where such damage occurs, it must be remediated as soon as possible and adequate compensation paid accordingly, which is in line with Anene et al., (2010).

Table 4; Prediction Equation, Correlation Coefficient and Coefficient of Determination of PVA Twine Diameters Soaked in Unpolluted waters of Fresh (0.4ppt), Brackish (25ppt) and Marine (25ppt).

Water Types	PVA Dia (mm)	Prediction Equation (Y)	Correlation Coefficient (r)	Coefficient of Determination (r^2)	Significant Levels (5%)
Fresh	4	$0.986X^2$-31.98X+ 298.4	0.699	0.489	S
	6	$1.125X^2$-4038.8X+ 366.1	0.800	0.640	S
	8	$9.091X^2$-353X+ 3448.7	0.929	0.863	S
	10	$11.79X^2$-518.6X+ 5534	0.933	0.871	S
Brackish	4	$3.42X^2$-115.6X+ 1015	0.586	0.343	S
	6	$2.287X^2$-76.55X+ 683	0.620	0.384	S
	8	$4.42X^2$-504.1X+ 4458	0.664	0.415	S
	10	$6.66X^2$-61.43X+ 5764	0.700	0.490	S
Marine	4	$1.565X^2$-53X+ 488.8	0.577	0.332	S
	6	$1.595X^2$-59.36X+ 44.6	0.593	0.352	S
	8	$1.821X^2$-116X+ 11.06	0.624	0.389	S
	10	$1.995X^2$-406X+ 76.00	0.666	0.444	S

Source: Field Survey, 2010. Note: S is significant ($p<0.05$) at 95% confidence value

Finally, as the twines get weakened, low tensile strength (kgf/mm) through AGO pollution or high intensity of sunlight as a means of drying effect after used, the intended fish to be caught with such low tensile strength twine, could easily tear the meshes and escape, resulting in less catches, loss of materials, increase labor for net repairs, increase production costs and less profits for the artisans which in turn leads to low economic development in the such fishing communities.

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