

Study The Physical And Mechanical Properties Of (Un Plasticized Polyvinyl Chloride) Pipes

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الخلاصة

تم في هذا البحث تحضير نماذج من أنابيب البولي فينيل كلورايد الصلب السعودي المنشأ والخاص بأنابيب الصرف الصحي بعد تقطيعها ودراسة الخصائص الميكانيكية والفيزيائية لها. تم دراسة مقاومه الصدمة والصلادة للنماذج بعد غمرها بالماء والمحلل القاعدي حيث أبدت المادة مقاومه صدمه وصلت إلى (80.44 J/m) بعد الغمر لفترة (6 weeks) في المحلول قاعدي بينما كانت قيمتها (91.82 J/m) بعد الغمر في الماء إما بالنسبة للصلادة فكانت (77.6) بعد الغمر في المحلول القاعدي و (62.11) بعد الغمر في الماء . أشارت النتائج إن الماء والمحلل القاعدي قد اثر على هذه الخصائص حيث تقل الصدمة والصلادة بعد الغمر، كما أشارت الدراسة إن نفاذيه الماء في هذه الأنابيب اقل من نفاذيه المحلول القاعدي.

ABSTRACT

UPVC (un plasticized polyvinyl chloride) samples prepared by cutting to study mechanical and physical properties . Hardness and impact strength properties were studied with conditions mentioned, base and distill water were the main environments studied on the samples prepared. When the maximum value of impact strength reach (80.44 J/m) after immersion (6 weeks) in NaOH , while in water it was (91.82 J/m).The hardness achieve (77.6) after immersion in NaOH and (62.11) in water . Results showed that the impact and hardness decrease after immersion in NaoH and H₂O. Water was diffusion in upvc less than NaoH .

INTRODUCTION

PVC (poly vinyl chloride) is one of the three major thermoplastics ,poly propylene(pp),poly ethylene(PE) and PVC being manufactured and used across the globe. Globally,around(60%) form of water/SWR/plumbing/Drainage pipes, window and door profile.[1]

UPVC or rigid PVC is often used in the building industry as a low-maintenance material. The material comes in arrange of colors and finishes [2,3].The same material has almost entirely replaced the use of cast iron for plumbing and drainage, being used for waste pipes, drain pipes, gutters and down pipes [4].

To make pvc useful for various applications, additives such as thermal stabilizers, lubricants, processing aids, colorants, UV stabilizers, fillers, etc are added to it before processing to ensure good mechanical, physical, thermal and electrical properties.[5]

MATERIAL AND METHODS

The pipes in this work made in Saudi Nation Company were cutting into dimensions of ASTM standard , D/N8061 for impact test and hardness. Some of the samples were immersed in (0.5 N) NaoH solutions and the others were immersed in distill water for different

period (1-6) weeks. Another samples immersed in distill water and in NaoH(0.5 N) solution for test of diffusion coefficient.

Equipments:

1- Impact test :

This instrument consist mainly of a pendulum and an energy gauge .Charpy impact test consists of standard test piece that would be broken with one flow of swinging hammer. The test piece is supported at both ends in a way that the hammer strikes it at the middle. The testing method of this instrument includes lifting of the pendulum to its maximum height and fixing it firmly. The specimen is fixed in its pertaining place and then the energy gauge is initialized (on zero position),after that the pendulum is freed whereas it potential energy would be changed to kinetic energy .Some of this kinetic energy is utilized to fracture the specimen ,which the energy gauge reads the value of fracture energy (Uc) for the sample under test. Impact strength (I.S) is calculated by applying the relationship:

$$I.S = U_c / A \quad \text{-----}(1)$$

Where U_c : fracture energy (Joule) which is determined from Charpy impact test instrument .

A : is the cross – sectional area of the specimen (mm²)

2- Shore hardness tester (HT -6510 D).

Shore hardness tester D (Durometer) determining the indentation hardness for plastics ,Formica ,Epoxies and Plexiglas .

Specification of shore D tester :4 digits ,10 mm LCD Range : 0-100 H
 Resolution :0.1

Measurement deviation :error≤± 1

Size : 162 *65 *28 mm.

3-Absorption test: this test used these equations:

$$\text{Weight gain\%} = (M_2 - M_1 / M_1) * 100 \quad \text{-----}(2)$$

$$D_x = \pi (k_t d / 4M_\infty)^2 \quad \text{-----}(3)$$

M₁=Weight of specimen after immersed.

M₂=Weight of specimen before immersed.

D_x=Diffusion coefficient.

d:thickness of specimen.

M_∞:Amount of liquid in specimen after saturation.

k_t: slope of curve between weight gain with root of time.

RESULTS AND DISCUSSION

1-Impact test :

This test was done to evaluate the impact strength of the specimens and study the effect of NaOH solution and distill water on this property. Fig (1,2) showed energy absorbed by specimens of their condition and these variations. The distill water had decreased value of impact strength of material. Also the NaOH solution decreased the impact strength. As this aggressive liquid and Water entry in polymer material is primarily caused by different and partly by the polarity of polymer chains that is caused by un balanced inter molecular forces. Molecules of water and NaOH that penetrate into the area between the polymer chains remain there and act like wedge between these chains and caused a damage in the inter face region of the UPVC.[6,7]



Fig.-1: Effect of H₂O with Impact strength

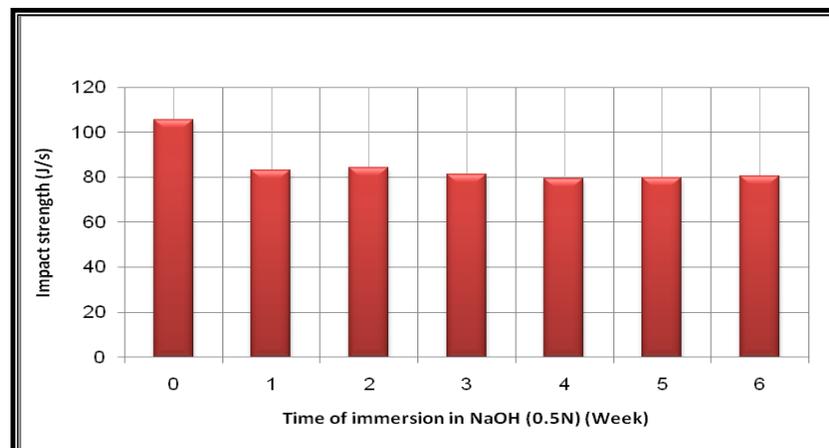


Fig.-2: Effect of NaOH with Impact strength

1- Hardness properties :

Fig (3,4) demonstrate the hardness (shore D) of the upvc pipes decreasing with time of immersion in H₂O and NaOH solution . Distill water and aggressive liquid as NaOH caused degradation in polymer and caused a damage in the inter face region, also the solution usually caused decreased surface's resistance that leads to decreasing the resistance of scratch [8].The effect of the NaOH solution and H₂O on the hardness shows that when the immersion time increases, the hardness decreases, this is a sign of a negative effect (bad effect) on the hardness because the solution will break the bonds in the polymer and form cavities which represent the weak regions in the UPVC pipes . [6,7]

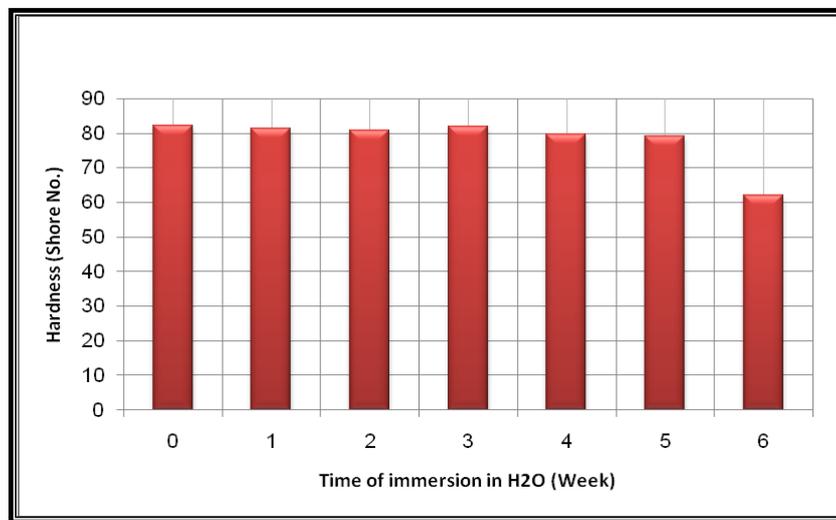


Fig.-3: Effect of H₂O with hardness

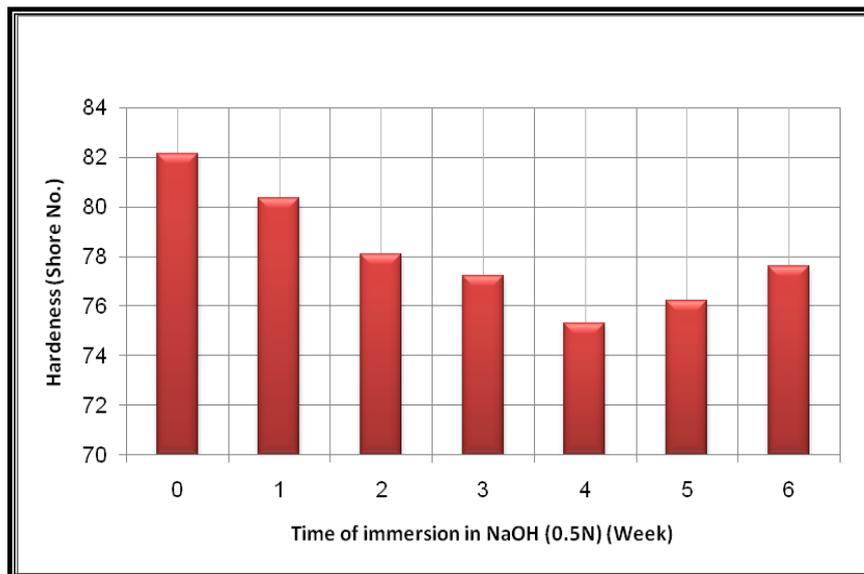


Fig.-4: Effect of NaOH(0.5 N) with hardness

3- Absorption test :

This test was done to evaluate the diffusion coefficient of solution in specimens. Fig (7) shows that diffusion coefficient of NaOH solution inside the specimens more than diffusion coefficient of distill water due to upvc had a low resistance toward the aggressive liquid[9], this is shown in fig (5,6,7)

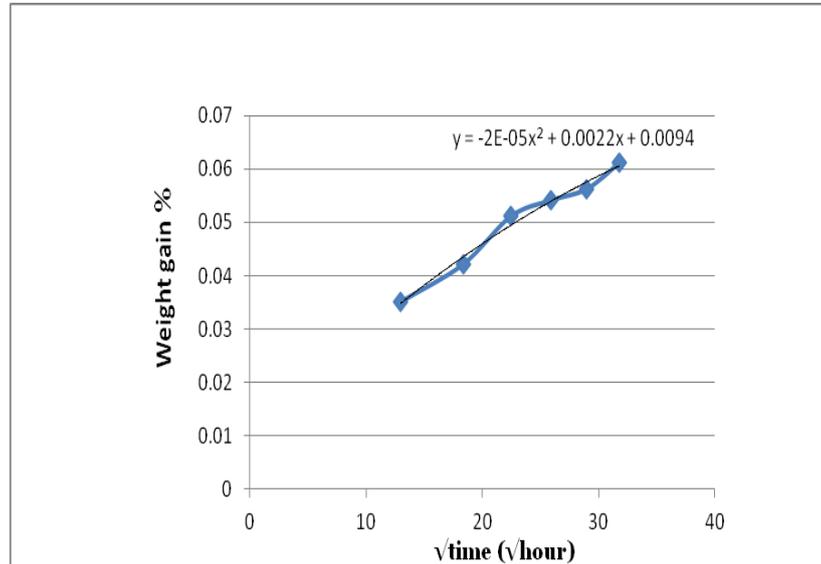


Fig.-5: Weight gain after immersion in water

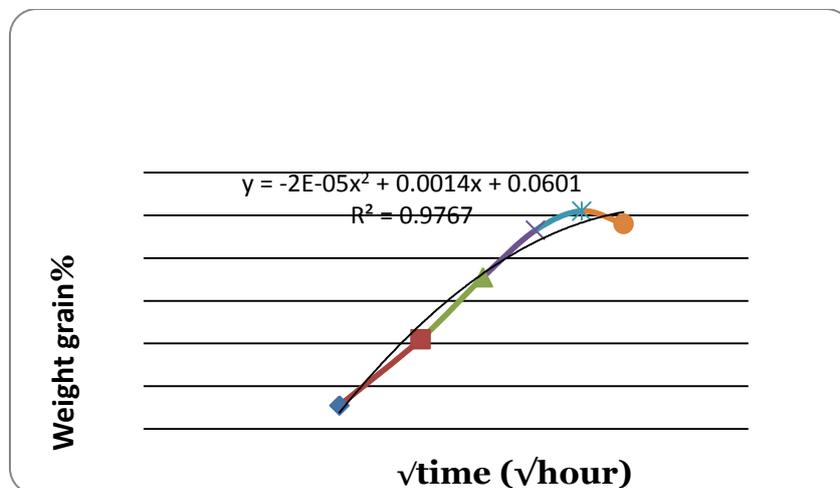


Fig.-6: Weight gain after immersion in NaOH(0.5N)

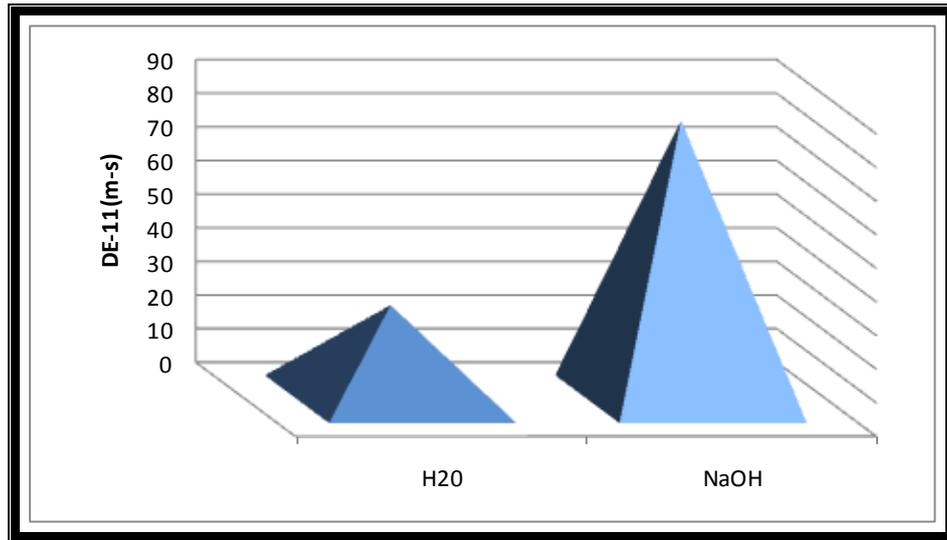


Fig. -7: Diffusion coefficient for H₂O and NaOH in pipes of UPVC

Conclusion:

- 1- Immersion in distill water and NaOH lead to decreasing in impact strength ,in addition the effect NaOH solution more than water.
- 2- Hardness decreasing when immersion in H₂O more than in NaOH.
- 3- NaOH solution diffusion in UPVC faster than H₂O ,therefore diffusion coefficient for NaOH solution greater than for H₂O .

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