

Notch effect on the behavior Mechanics to fracture of intake pipes for drinking water rigid PVC.

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ABSTRACT

We studied the mechanical behavior of a polyvinyl chloride (rigid PVC) subjected to tensile tests, the notch effect is highlighted. The approach is to study and analyze the evolution of the overall geometry of the stress-strain curves or Force-displacement The work presented here is part of a comprehensive study to compare two kinds of pipes, degraded and non-degraded, in order to know the real causes of degradation of the mechanical intake pipes for drinking water.

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Introduction:

Most plastic materials are amorphous polymer original materials as PE (polyethylene), PVC (polyvinyl chloride) is flexible or rigid, because of their importance we find more materials in the supply pipeline sector drinking water, the sanitation. etc [1].

This article provides an update on a comparative study of the same supply pipe dimensions of rigid PVC drinking water, this comparison treats the causes of mechanical degradation of pipes used based on a static study of non-degraded pipes, the mechanical degradation, involving pre cracks of rigid PVC tubes, applying a system of forces and submitting her to a crack open mode (mode I).

Matériels et méthodes :

Test specimens and testing devices:

The specimens used for comparison were taken from a same conduct whose dimensions are as follows (Fig.1): They consist essentially of polyvinyl chloride (rigid PVC) of gray color and come from the same casting.

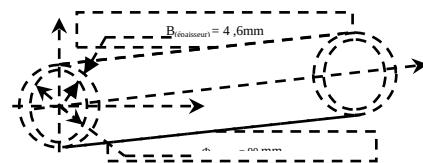


Fig. 1: Schema of a rigid PVC pipe

The ISO 527-2 standard, allow ourselves to be dumbbell shaped specimens uncracked (fig.2et table.1) this types of specimens demonstrate the static study for non-degraded pipes, the reason determine the mechanical proprieties ($E, \sigma_R, \sigma_m, \epsilon_R, \epsilon_m$).

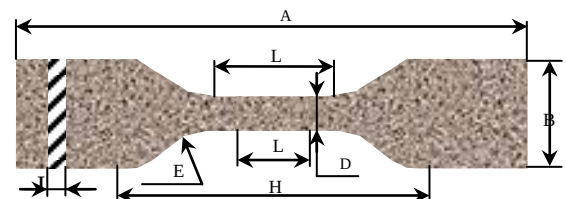


Fig. 2: Geometry of the specimen for the tensile test

Table: 1. the dimensions of the dumbbell specimen for the tensile test [2]

Symbole	Description	Dimensions (mm)
A	Minimum total length	115
B	Width at the ends	25±1
L	Length of the calibrated portion	33 ±2
D	Width of the calibrated part	6 ±0.4
E	Small bending radius	14 ±1
L	Gauge length	25 ± 1
H	Initial distance between jaws	80 ±5
I	thickness	4,6

ISO 17817 [3] is intended to determine the size and geometry of pre-cracked specimens fig.3 and table .2),

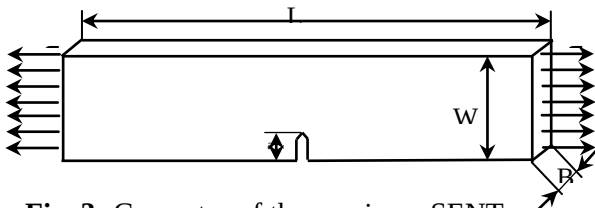


Fig. 3: Geometry of the specimen SENT

Table: 2. The specimen dimensions SENT to the tensile test

Symbole	Description	Dimensions (mm)
L	Length of the specimen	100
W	Width of the specimen	10
B	specimen thickness	4,5
a	Interval of the notch length	$2 \leq a \leq 6$

Results and discussion:

Stress / strain curves:

Analysis results for the mechanical characterization of healthy rigid PVC tubes:

The Fig.4 represents the evolution of the stress versus strain or we define the different phases of testing process to failure.

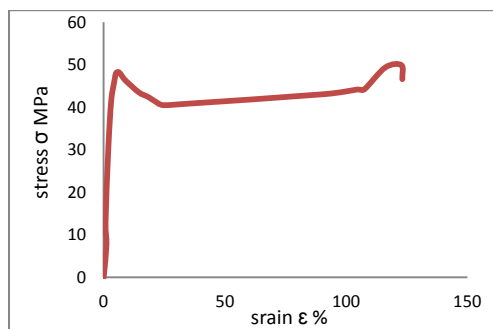


Fig. 4 : Parameters and domains determined from the curve stress -deformation in nominal terms

($v = 4\text{mm/min}$).

The plastic deformation of the polymers is a short-term irreversible phenomenon which gives rise to instabilities in various scales of observation:

- At the microscopic scale (a few nanometers) changes waterfalls conformation of macromolecules.
- On the macroscopic scale (a few millimeters): widespread constriction of the specimens.

This classification of phenomena is necessarily arbitrary because some instabilities develop at several levels simultaneously.

Analysis of the results of pre-cracked specimens Rigid PVC:

Curves force / displacement:

The Fig.5, shows the evolution of load / displacement of three different lengths of notches, we see that the results obtained on notched specimens show the same evolution for different lengths of taps, Note also that the importance the ductility of the material gives it a non-linear behavior.

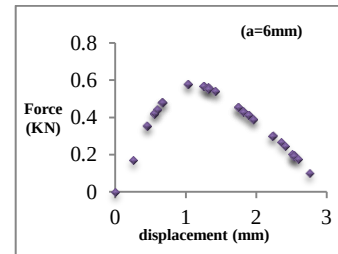


Fig. 5 : Evolution of force-displacement in different length notch $a=6\text{mm}$

The fig.4 and 5, show a great difference especially in the part of the plastic zone, the test pieces to the healthy state show great plasticity that notched specimens, which means that the pre-cracking specimens were inferior mechanical properties those unnotched.

Conclusion

This work consisted of determining the mechanical fracture behavior of pre cracked specimens of different length notches subjected to a static stress in mode I, following the gradual evolution of the crack, from this study we found that 'there is a loss of mechanical properties of precracked specimens, this means that the notch effect is not in favor of industrial ..

References:

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2. DIN ISO 527-2.Determination of tensile properties of plastics.
3. ISO 17282. Determination of impact fracture toughness of polyethylene using arc-shaped specimens.