

New Modified Tear Test

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ABSTRACT

Numerous rubber tear tests have been used for rubber evaluations. The various methods include crescent tear (ASTM D624 Die C), notched crescent tear (ASTM D624 Die B), T-peel (ASTM D1876-01), and trouser tear (ASTM D624). Various trouser tear geometries have been developed (ASTM D624 and D470). One of the preferred geometries is molded groove trouser tear. In recent work a method to make molded groove trouser tear test specimens for components extracted from tires has been developed. Various techniques for making the groove were evaluated to determine a preferred method.

KEY WORDS

Molded groove trouser tear, groove preparation method

SUBJECT

New molded groove trouser tear test method for components extracted from tires and molded rubber goods.

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SCOPE

In recent work a method to make molded groove trouser tear test specimens for components extracted from tires has been developed. Various techniques for making the groove were evaluated to determine a preferred method.

INTRODUCTION

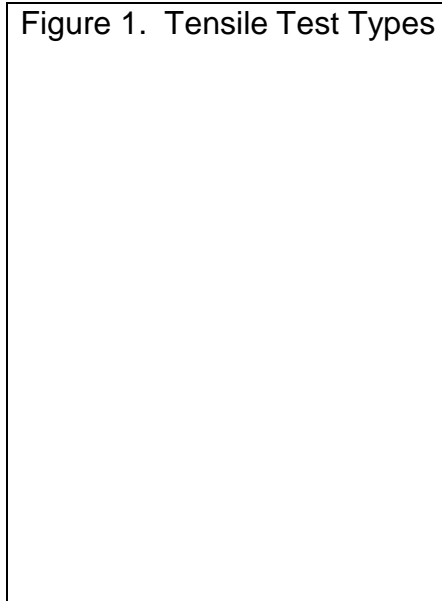
Numerous rubber tear tests have been used for rubber evaluations. The various methods include crescent tear (ASTM D624 Die C), notched crescent tear (ASTM D624 Die B), T-peel (ASTM D1876-01), and trouser tear (ASTM D624). Various trouser tear geometries have been developed (ASTM D624 and D470). One of the preferred geometries is molded groove trouser tear.

RESULTS AND DISCUSSION

Tensile Test Geometries

Several tensile test geometries have been used in our laboratory. In Figure 1 we see ASTM D412 die C and ASTM D412-98a mini-dumbbell and DIN 53504-S3.

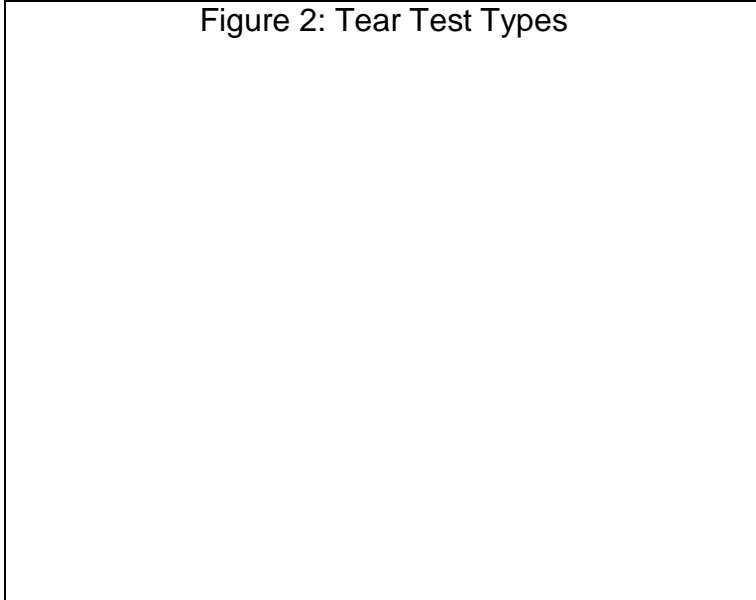
Figure 1. Tensile Test Types



Tear Test Geometries

Numerous rubber tear tests have been used for rubber evaluations. In Figure 2 various methods including crescent tear (ASTM D624 Die C), notched crescent tear (ASTM D624 Die B), trouser tear (ASTM D624), and D470 mini-trouser tear. The crescent tear (ASTM D624 Die C) and notched crescent tear (ASTM D624 Die B) are close to a tensile test with a notch. The trouser tear method is a good geometry for measuring tear; but, often tears out the side (not down the middle).

Figure 2: Tear Test Types



T-peel Tear Test Geometry

The T-peel (ASTM D1876-01) has a good tear geometry. It is also useful for adhesion testing for laminates in a rubber composite. Figure 1 shows an example of a T-peel test with a Mylar window to control the width of the interface (tear zone). This type of test method has worked well for the peel strength between belts of tires and adhesion of sidewall compound to carcass.

Figure 3: T-peel Tear Test



Molded Groove Trouser Test Geometry

A preferred geometry for good for quantifying tear properties which has good reproducibility is the molded groove trouser tear. For compounds extracted from tires and molded rubber goods, there was a need for a good tear test method. The mini-trouser tear (ASTM D470) and the trouser tear (ASTM D624) have been used; however, often tears out the side (not down the middle). For this reason, we tried too develop the ability to make grooved trouser test specimens from samples (slices) extracted from tires and molded rubber goods.

Figure 4: Molded Groove Trouser Tear Test



Machine Grooved Trouser Test Geometry

The ability to make grooved trouser test specimens went through a development process. We were using a CNC machine with various cutting tools. First we tried a 0.045 inch flat end mill, but the grooves were not smooth. The results had a lot of scatter and lower values were obtained. Then we tried a 0.032 inch ball end mill. Again, the groove was not smooth. Then we tried a Demel® tool (Figure 5) for making the grooves. Samples were prepared with and without water as a cutting lubricant. Good grooved tear specimens were obtained from slices extracted from tires. The test results were compared to the results from molded groove tear test specimens. The results were very similar to molded groove trouser tear (Figure 6-8).

Figure 5: Fabricating a Grooved Test Specimen

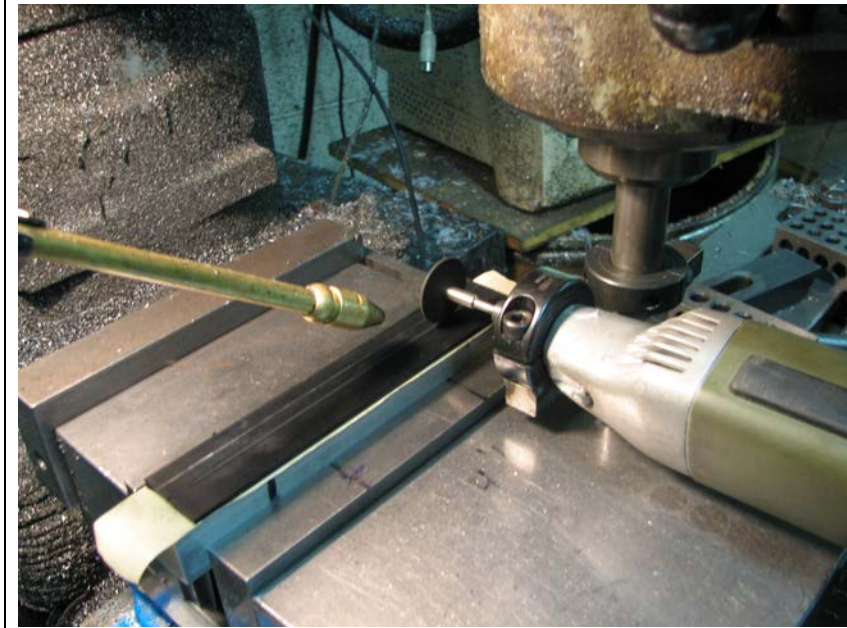


Figure 6: Comparison of Molded Groove to Machine-Grooved Tear Results

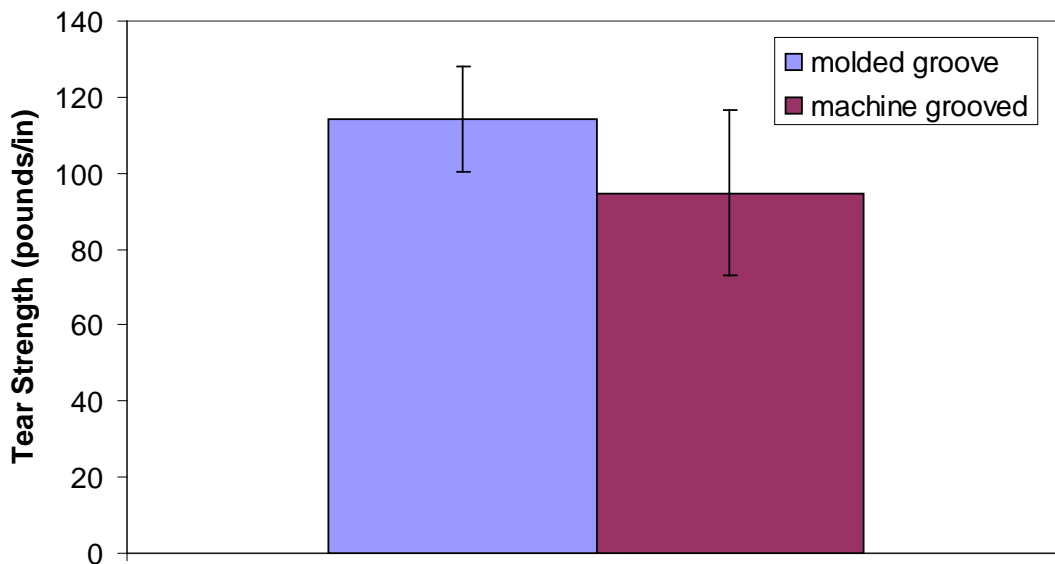


Figure 7: Force versus Displacement of Molded Groove Specimen

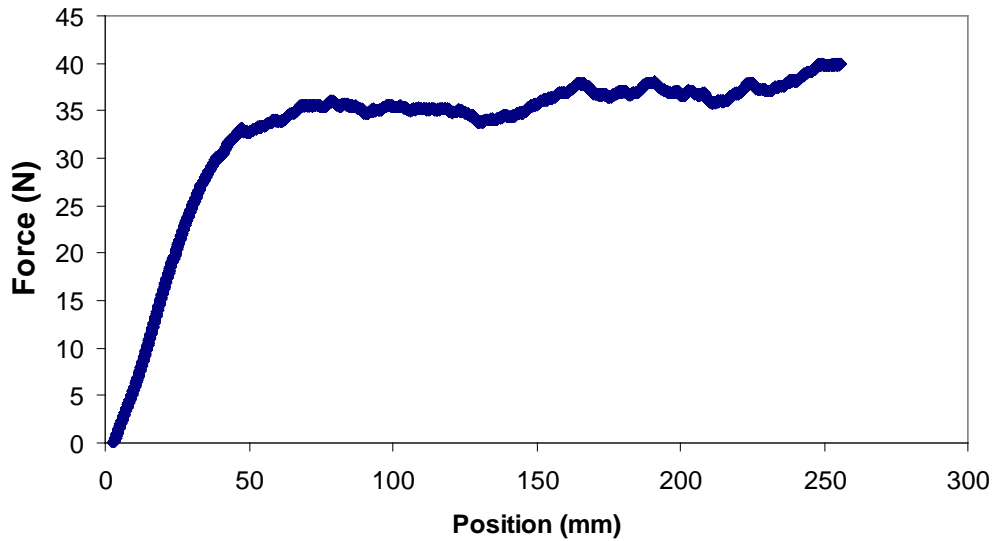
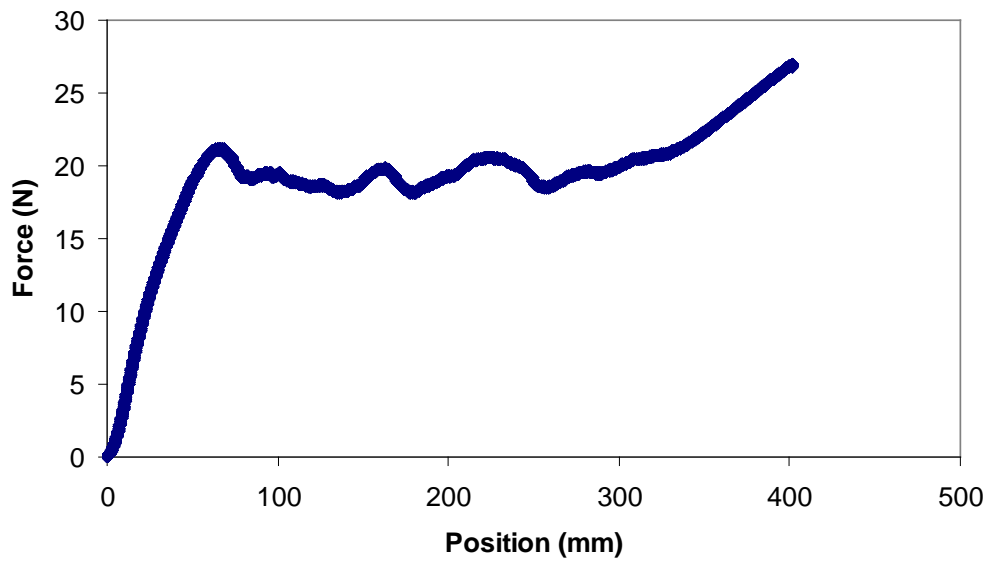


Figure 8: Force versus Displacement of Machine Grooved Specimen



CONCLUSIONS

- A method to prepare tear test specimens from tires and molded rubber goods have been developed and show to yield good results.