



Influence of cork particles on the impact strength of adhesives

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Objectives

- Cork particles should **create obstacles** to the propagation of the cracks, thus improving the **toughness** of the adhesive.
- The evaluation of this solution will be made by:
 - Powder characterization,
 - Production of specimens to evaluate adhesion between resin and cork and good particle distribution;
 - Mechanical tests.

Methods to improve toughness

There are three main methods to improve the toughness of adhesives:

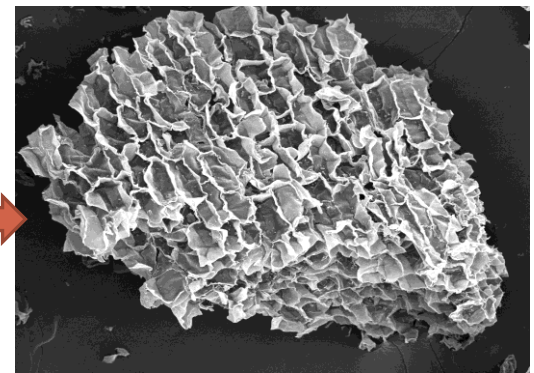
- Polymer with phase separation;
- Polymer without phase separation;
- Inclusion of particles.



Micro particles
of cork powder

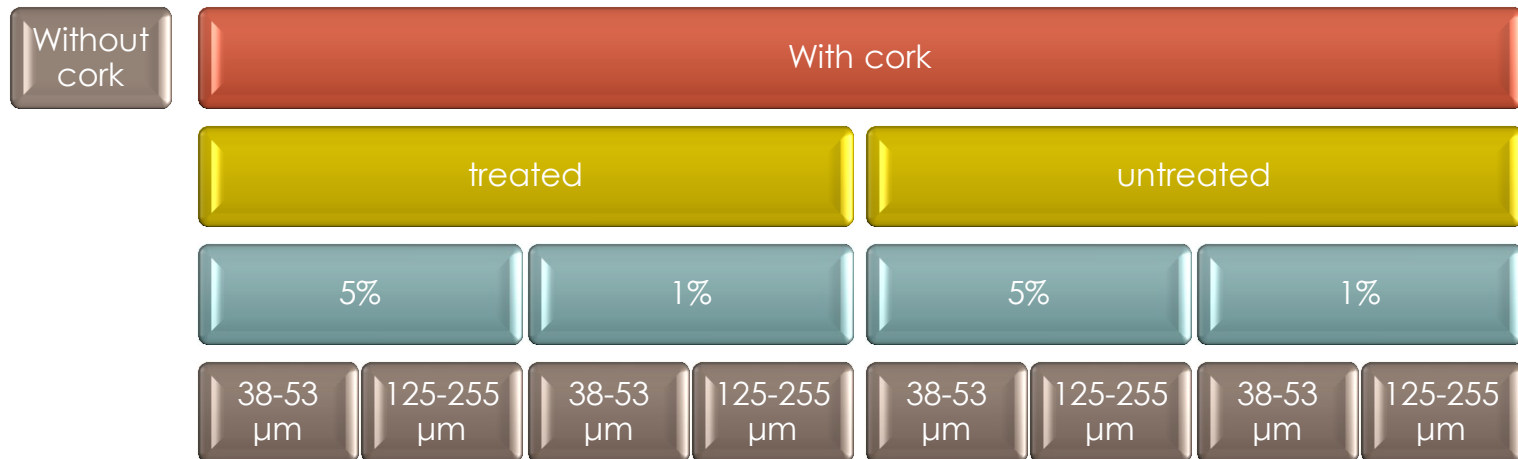
Cork as reinforcement material

- Cork is a biological material with unique properties;



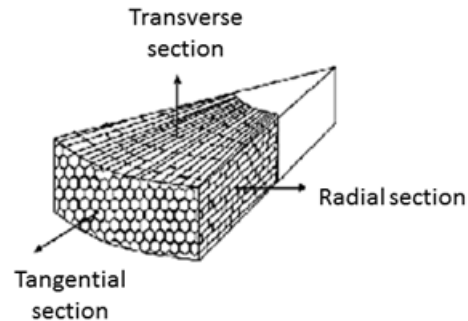
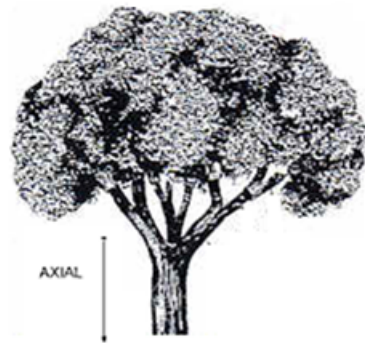
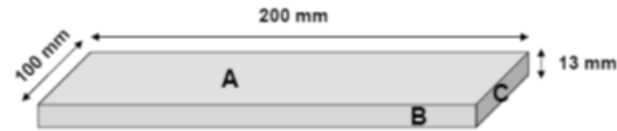
Specimen manufacture

- Materials
 - Cork Powder (38-53 μm and 125-250 μm)
 - Epoxy resin – Araldite 2020
- Types of Specimens :



Surface treatment and density

- Atmospheric Plasma

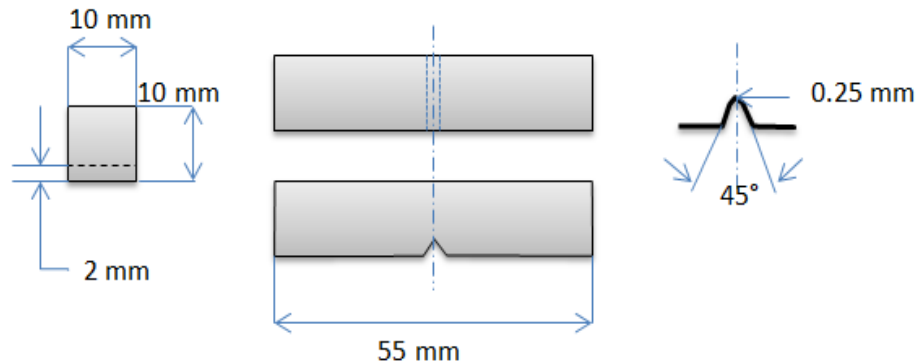


- Density

- Cork particles – Helium picnometer;
- Specimens – Archimedes principle (water)

Toughness impact test and SEM

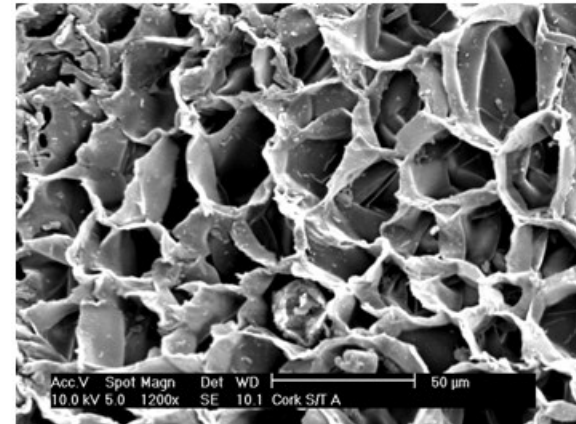
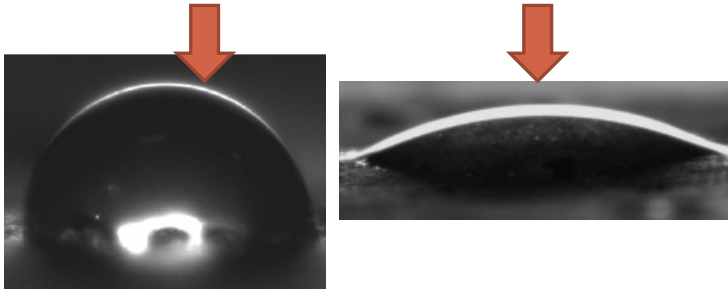
- Toughness impact test



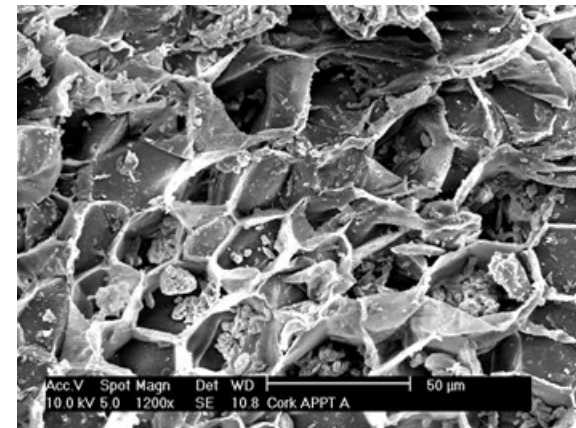
- SEM analysis

Surface properties

<i>Section</i>	<i>Treated specimen</i>	<i>Untreated Specimen</i>
Radial	30 ± 4	101 ± 11
Tangential	33 ± 7	99 ± 18
Axial	37 ± 2	103 ± 7



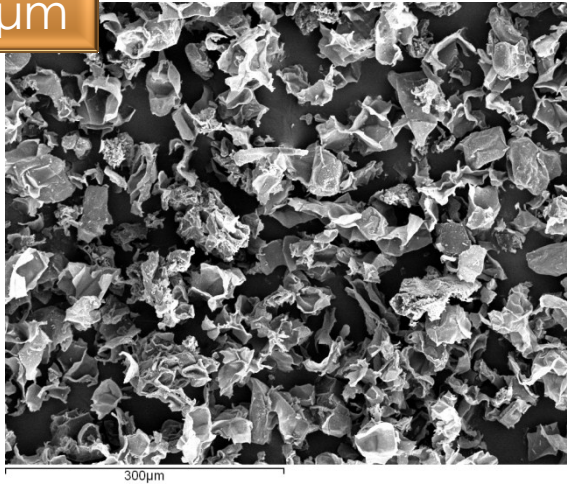
Untreated



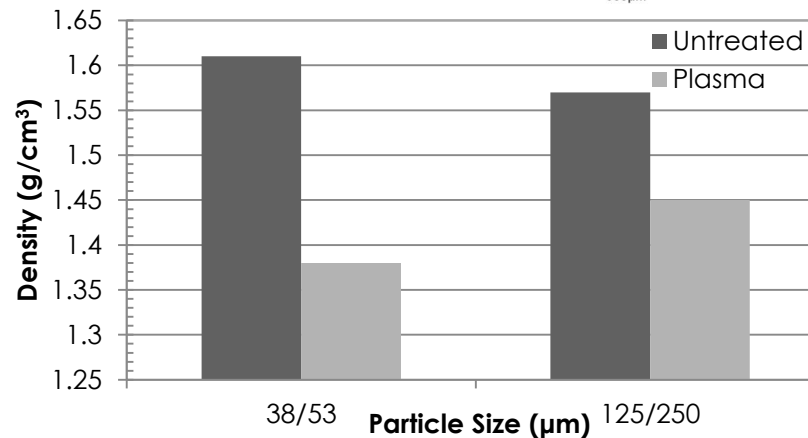
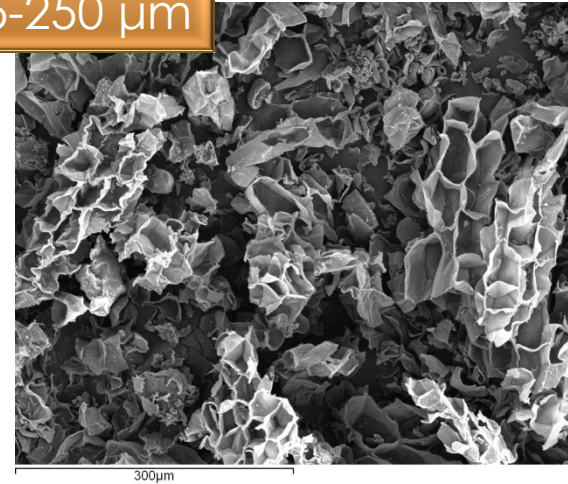
Treated with plasma

Cork particles characterization

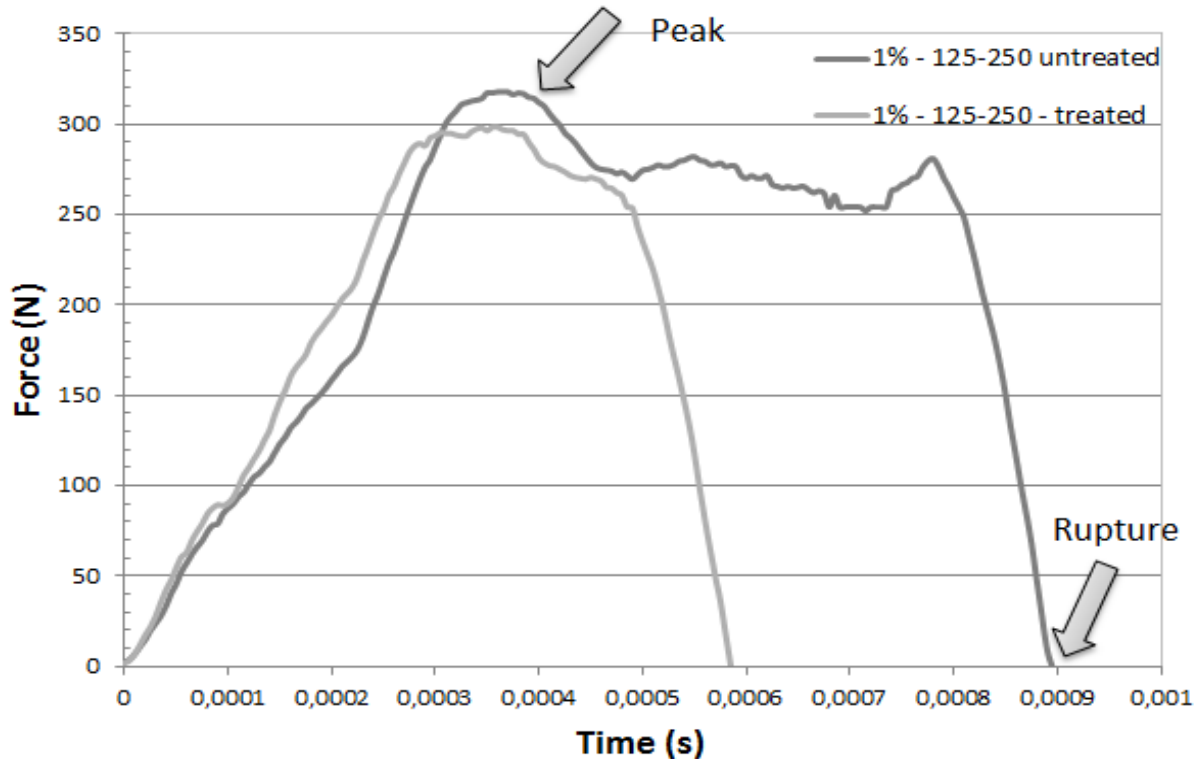
38-53 μm



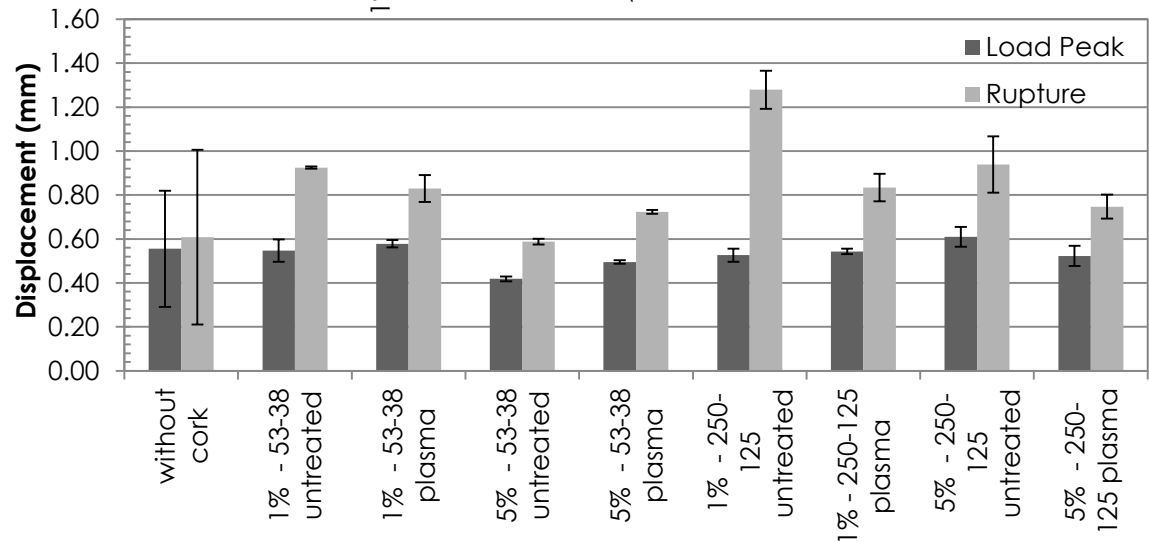
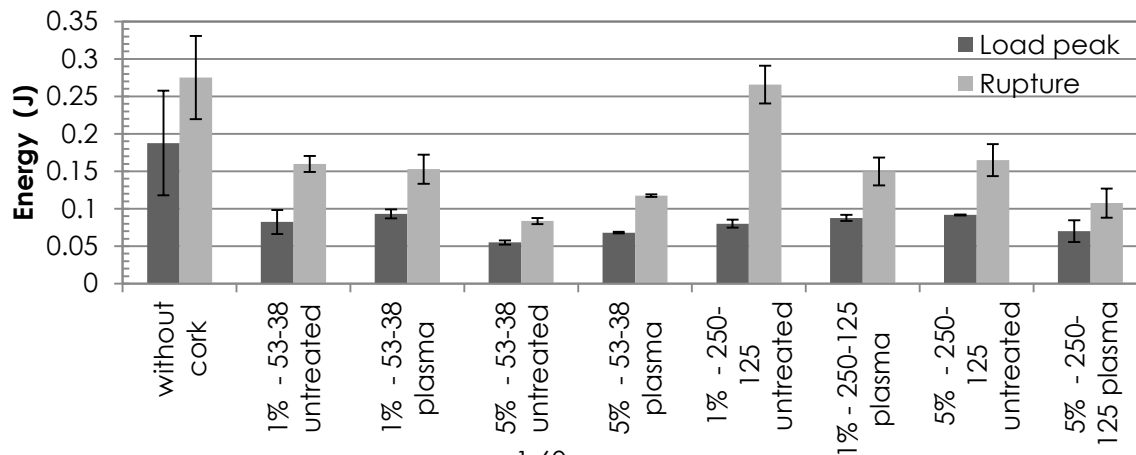
125-250 μm



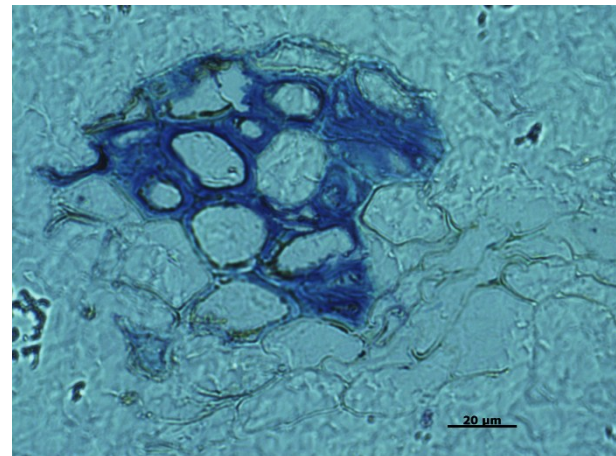
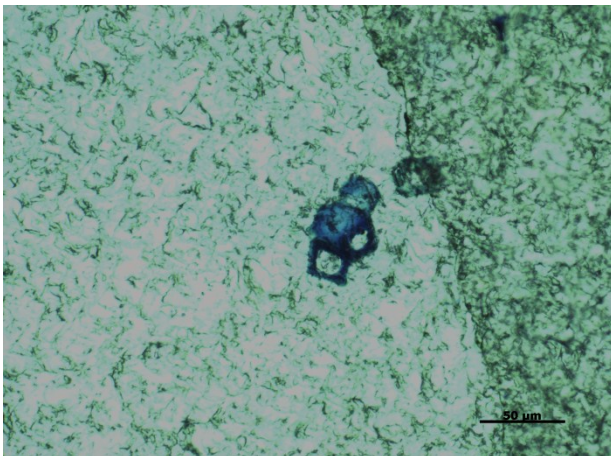
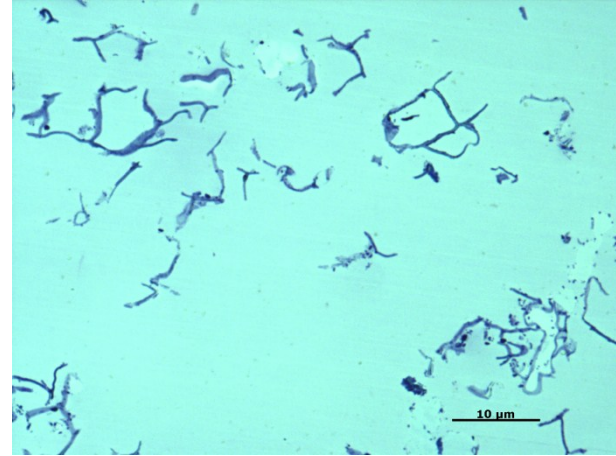
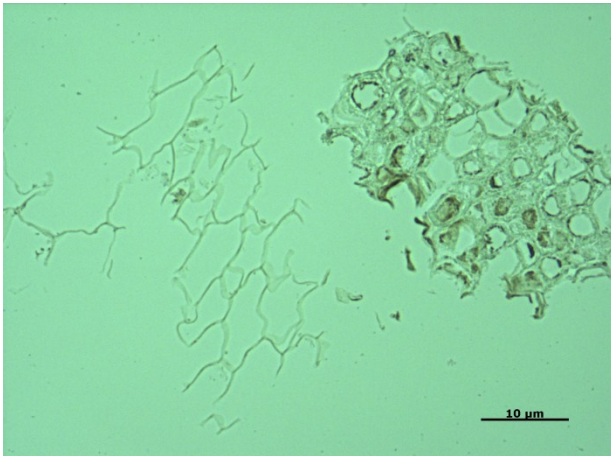
Toughness impact properties



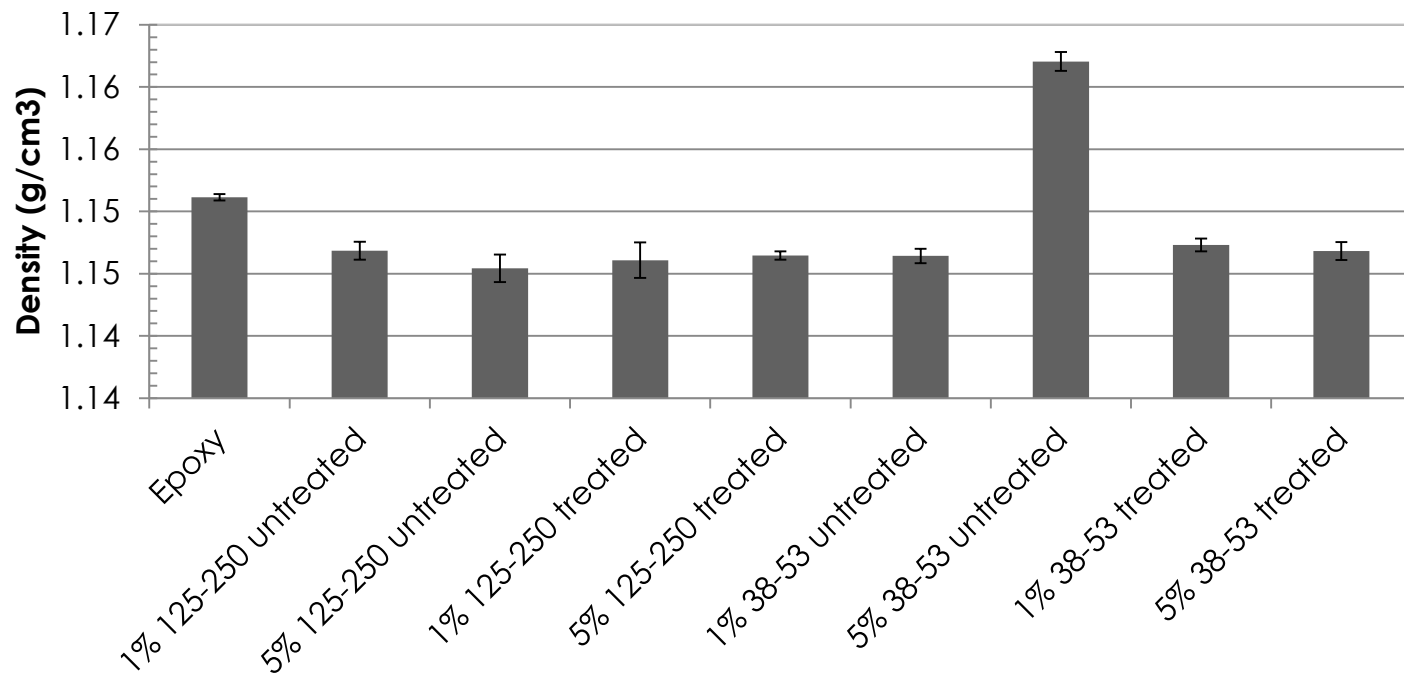
Toughness impact properties



Cork particles in resin

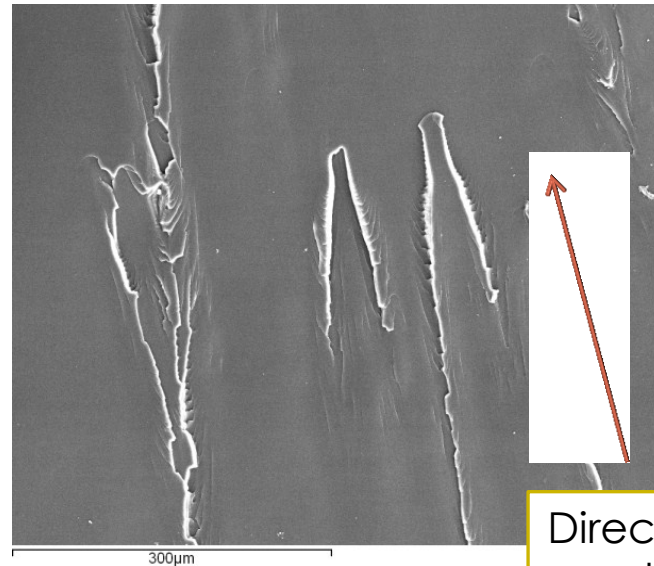
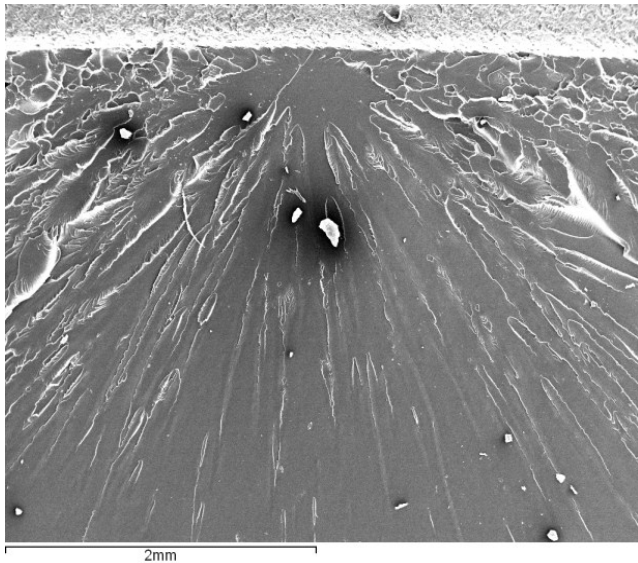


Density of toughness impact specimens



SEM Surface analysis

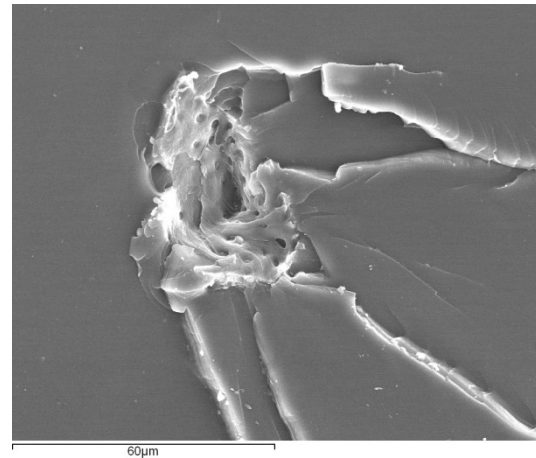
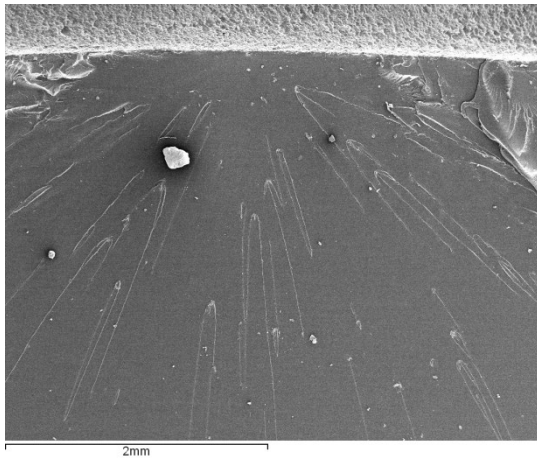
Without cork particles



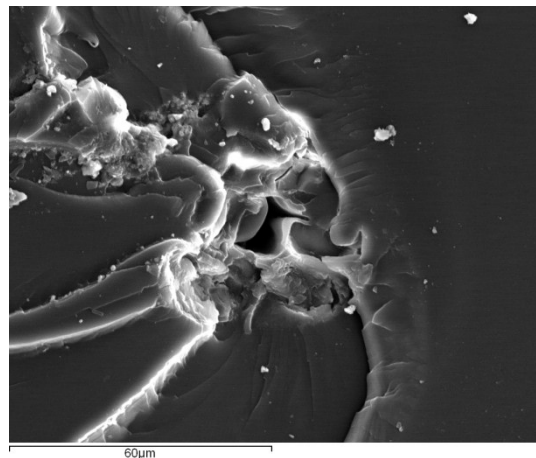
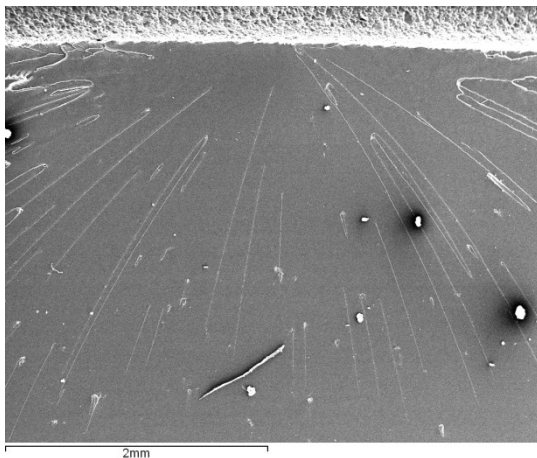
Direction of crack propagation

SEM Surface analysis

1% cork (38-53 μm)



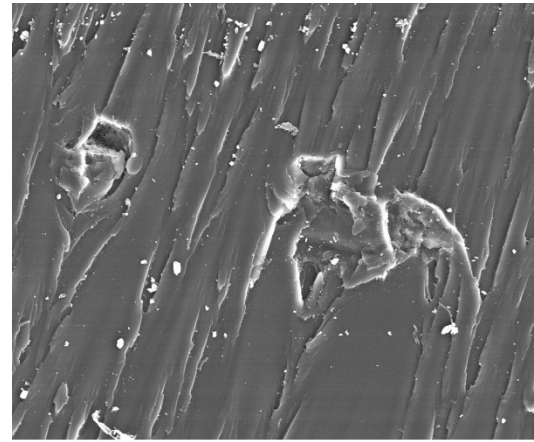
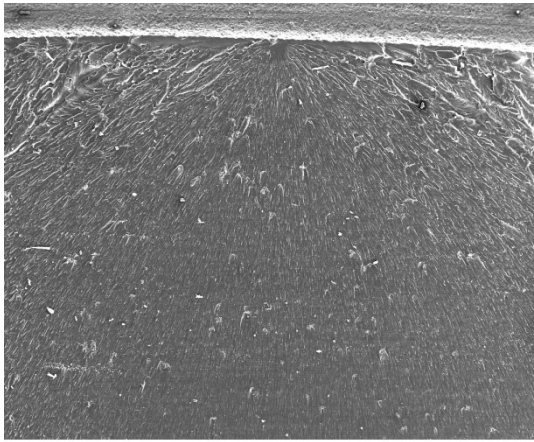
Untreated



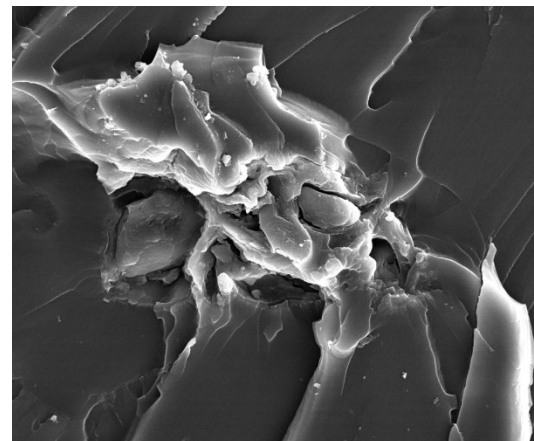
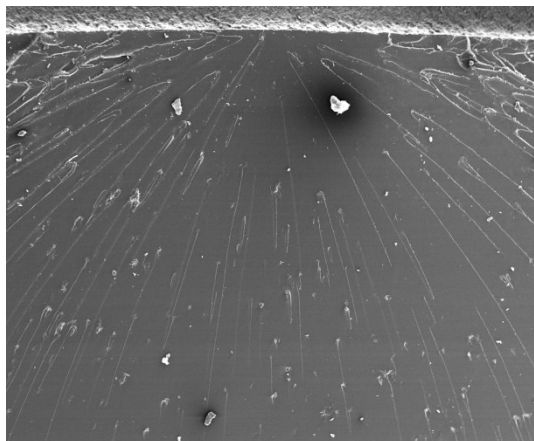
Plasma

SEM Surface analysis

5% cork (38-53 μm)



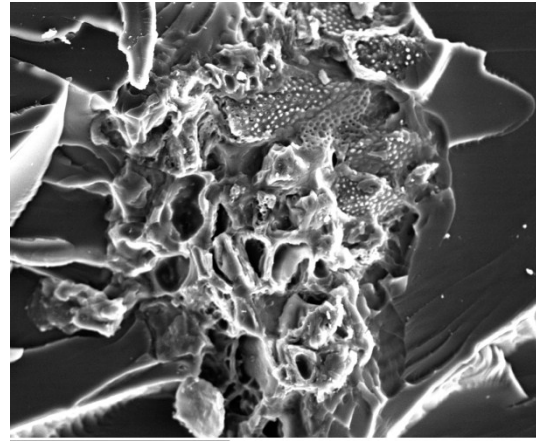
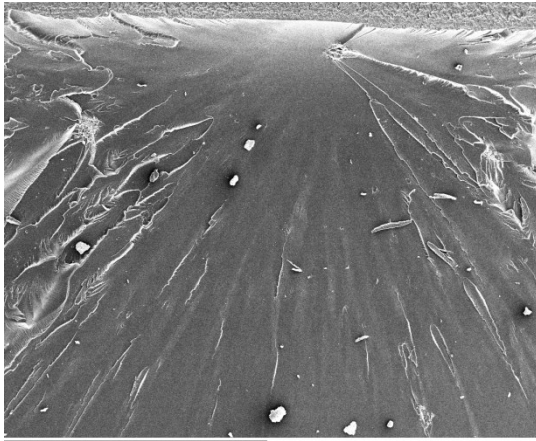
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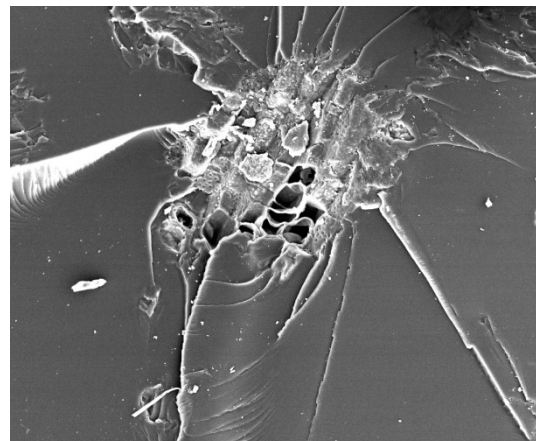
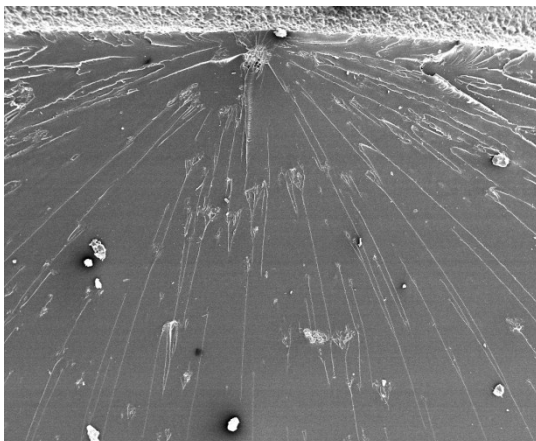
Plasma

SEM Surface analysis

1% cork (125-250 μm)



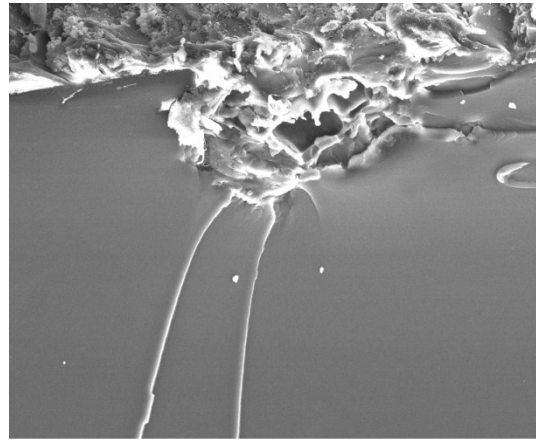
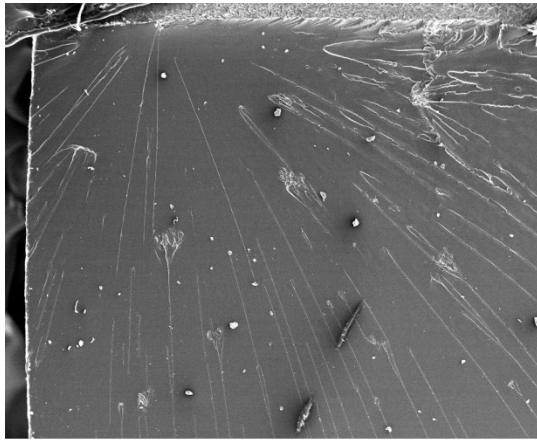
Untreated



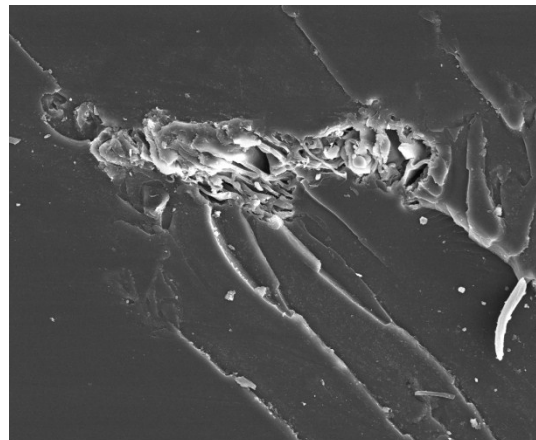
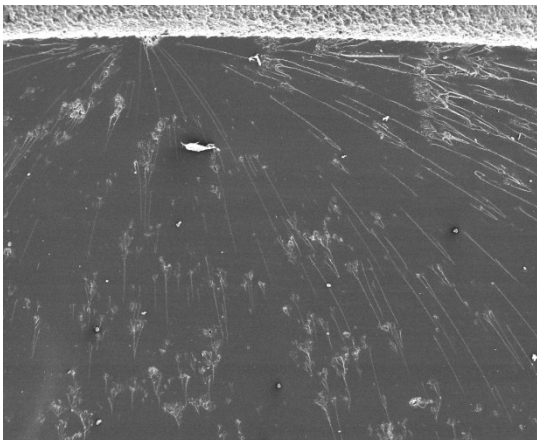
Plasma

SEM Surface analysis

5% cork (125-250 μm)



Untreated



Plasma

Conclusions

- Atmospheric plasma surface treatment increases the contact angle and wettability of cork;
- SEM and OTM analysis show that most of cells are not filled with resin;
- The influence of the particle size is notorious.

Acknowledgements

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