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Atmospheric Pressure Plasma activation of natural fibres for improved matrix interaction

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Several investigations have shown that plasma activation is a suitable, environmental friendly method to modify fibre materials. Depending on the plasma chemistry, the surface energy and also the topography of fibres can be significantly changed which can lead to an improved wettability and surface chemistry. This is of particular interest during subsequent processing steps if fibres are implemented into fibre-reinforced polymers (FRPs).
The processing of natural fibres is particularly difficult because their surface chemistry and topography are highly inhomogeneous and depend on the natural growth of the fibres. Additionally, the chemistry of cellulose, hemicellulose, pectin and lignin is not compatible with a lot of matrix systems. One possibility to improve the adhesion between natural fibres and matrix systems is to treat the fibres with cold plasma at atmospheric pressure. Hereby, beside a gentle surface cleaning, functional groups are formed on the fibre surfaces.
Usually, the matrix material is often heated to lower its viscosity before impregnating the fibres. Therefore, it is important to know if the functional groups sustain the heat influence and still allow for a better impregnation.
In this work surfaces of natural fibres were activated by a cold atmospheric pressure plasma source that offers a high treatment width and can be easily integrated into processing chains with regard to industrial applications. After activation the fibres were characterized by SEM, XPS, tensile testing and adapted wetting measurements by a Wilhelmy balance. Additionally, fibres were heated under defined atmospheres to simulate the temperature effects during the injection process.
The results show an increase of oxygen containing groups and surface energy of the fibres after the plasma treatment. However, these activation effects were highly reduced after heating of the fibres. Thereby, the level of remaining activation effects depended on different plasma treatment parameters.

Keywords
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natural fibres