

High vacuum set up for O₂ and CO₂ transmission rate measurements of films for food packaging.

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A versatile high vacuum set up developed for permeability measurements of materials to any gas has been described in ref. [1]. The apparatus, equipped with a residual gas analyzer and a spinning rotor gauge, can measure permeability and diffusivity of gases through different materials by membrane technique, guaranteeing versatility and accuracy. In this work we show its use for food packaging film characterization. Materials employed for the films under study are the following polymers: Polylactic Acid (PLA), Polybutylene Adipate Terephthalate (PBAT), Polybutylene Succinate (PBS). The transmission rate of O₂ and CO₂ is measured for each raw material and for modified versions that have been coated by plasma techniques with thin film of SiO_x to increase gas barrier [2]. To complete the results, we also show oxygen permeation test through zein-based films with a bioactive extract useful for active packaging production. The values of gas transport quantities are extremely low for this kind of samples, consequently we present the ultimate resolution of the apparatus, showing its limits and possible artefacts. We report a comparison between our vacuum-based apparatus and infrared or coulometric sensing technology employed in commercial instrumentations. The comparison is focused on pros and cons of the two different approaches.

[1] Firpo G., Setina J., Angeli E., Repetto L., Valbusa U., *Vacuum*, 191 (2021) 110368.

[2] Pedroni M., Vassallo E., Aloisio M., Brasca M., Chen h., Firpo G., Ghezzi F., Morandi S., Pietralunga S.M., Silveti T., Virgili T., *Coatings*, 11 (2021) 1281.