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Hydrogel: the influence of oxygen on the properties of PVP membranes

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Abstract –The aim of this study is to verify the influence of dissolved oxygen on the synthesis of PVP hydrogels membranes. The hydrogels were prepared in different conditions (i.e., with oxygen dissolved and replacing the oxygen dissolved by nitrogen). The samples were crosslinked by gamma rays. The gel fraction and swelling kinetic in hydrogels membranes were analyzed to study the influence of natural oxygen in membranes prepared. The swelling results showed large differences on cross linking densities from samples irradiated with and without oxygen, however no difference was verified on gel fraction.

Hydrogels are insoluble, cross linked polymer network structures composed, which have the ability to absorb significant quantity of water. Due to their significant water content, hydrogels also possess a degree of flexibility very similar to natural tissue, which minimizes potential irritation to surrounding membranes and tissues[1]. Radiation methods are especially attractive for creating such gels because no additives are needed, the process is easily controlled, and the economy is competitive when compared to other, more conventional methods[2]. The amount of water in the equilibrium swollen state is a balance between the thermodynamic force of mixing (hydration) and the retractive force of the three-dimensional network. The mixing force depends mainly on the hydrophilicity of the polymer and the retractive force on the number of cross links connecting polymer chains into a three-dimensional network[3]. Under irradiation, the absence of oxygen provides the cross linking process more efficient than in its presence because the oxygen promotes degradation of the polymer. In impermeable sealed packaging with presence of oxygen, as in this study, after an initial period where the degradation prevails, the oxygen is consumed and then the gel formation dominates[4].

To hydrogel preparation 12% and 20% poly(N-vinyl-2-pyrrolidone)(PVP), by weight, was dissolved in distilled water and the samples of each series, A with 20% PVP and B with 12% PVP, which were divided into two: in sample 1 was bubbling nitrogen and no special treatment was used in sample 2. The samples were irradiated with gamma rays from a ^{60}Co. To determine gel fraction the sol was extracted in soxhlet for 40hs and to determine degree of swelling the hydrogels were immersed in distilled water until confirm the equilibrium state of swelling.

Finally, with or without oxygen, the results obtained on samples didn´t show differences on gel fraction (tab. 1) however the swelling (tab. 1, fig. 1 and 2) showed large differences on cross linking densities.

Table 1: The gel fraction and maximum swelling of hydrogel membranes

Samples	Gel fraction (%)	Max. Swelling (%)
A1	95,7 +/- 5,2	253 +/- 3,5
A2	95,9 +/- 1,3	388 +/- 13,9
B1	96,3 +/- 0,2	89 +/- 12,6
B2	94,5 +/- 0,7	178 +/- 10,4

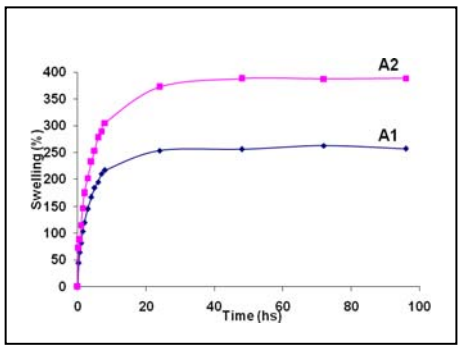

Figure 1: Swelling of samples A1 and A2 of hidrogels with 20% PVP,

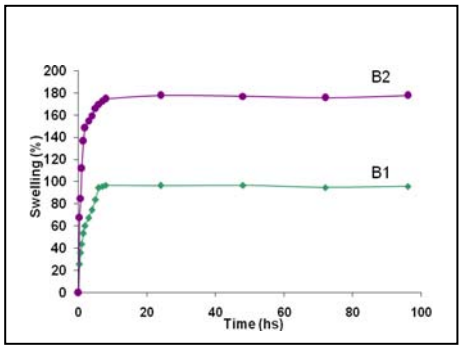

Figure 2: Swelling of samples B1 and B2 of hidrogels with 12% PVP.

References

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