MSE-6: Crosslinking PVA (Polyvinyl Alcohol) for Knitted Hernia Mesh

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Problem Statement:

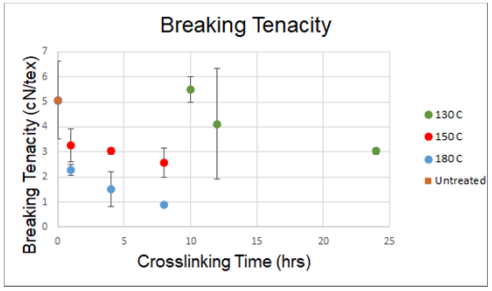
Hernia repair surgery is performed on millions of people a year. A number of meshes used to repair the hernias cause discomfort. How can PVA be crosslinked to fulfill the requirements of being biocompatible, mechanically strong and degrades slowly for adequate tissue integration?

Approach:

Examined the effect of crosslinking based on mechanical properties, solubility, and structural properties:

- Crosslinked yarn at 150°C and 180°C for 1, 4, and 8 hours.
- Characterized samples using FTIR and DSC.
- Performed mechanical tests on the individual yarns to determine the breaking tenacity and ultimate tensile strength.
- Repeated the above tests on different knit structures.

Results:



Breaking tenacity at the different crosslinking conditions compared with untreated PVA

Heat Treatment Crosslinking			
Temp.	130 °C	150 °C	180 °C
Time (hours)	10	1	1
	12	4	4
	24	8	8

Crosslinking conditions with pass (green), fail (red) when yarns are placed in DI water

- DSC – showed no change in glass transition or crystallization temp.
- FTIR – showed –OH functional groups decreased with more crosslinking.
- PVA yarns did not dissolve in water after crosslinking at 150°C for 8 hrs.
- PVA tensile strength decreased with increased heat and crosslinking time.

Discussion & Conclusions:

- Test results showed that PVA had undergone a chemical change after being heated, as indicated by a color change, changes in IR spectra, and a change in mechanical properties, indicating that crosslinking had occurred.
- There was a reduction in yarn size after crosslinking. Yarns on average shrank by ~30% and the knits shrank by ~50% which must be taken into consideration for dimensional considerations.
- Heating the PVA at 150 °C for 8 hours was found to be the best since it did not sacrifice mechanical properties and the PVA did not dissolve in water.

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