



# EVERYTHING YOU WANTED TO KNOW ABOUT HYDROGEL, BUT WERE AFRAID TO ASK....

## WHAT IS A HYDROGEL?

Hydrogels consist of pretty much nothing but water held together by a very small amount of long molecular chains called polymers. Hydrogels are soft (think squishy) and wet materials with properties similar to those of body tissues.

The gels can be tailored for different mechanical properties and can even be made to conduct electricity. They can also respond to external stimulations by changing their volume. At present they are the focus of much research for use in bionic implants and as scaffolds for tissue growth, including replacing damaged spinal cords. They could also be used for improving how robots flex and grip objects.

The polymer chains used in hydrogels can be synthetic or can be from natural sources (such as shrimp shell or seaweed). Many cosmetic products and food additives are made of such polymers. Conventional hydrogels are mechanically weak, but there are techniques that UOW and others have pioneered to make considerably tougher hydrogel.

## WHY USE TOUGH HYDROGELS FOR CONDOMS?

The short explanation is that they can be designed to feel more like human skin than latex rubber. They can also be completely transparent, so they will be invisible. We can make tough hydrogels very thin that are stronger than conventional hydrogels. So we hope to deliver a condom that is safe and feels and looks better.

**"Designed to feel more like human skin than latex rubber."**

At University of Wollongong (UOW), the Bionic Artificial Muscles team ([\*BionicMuscles Channel\*](#)) led by Professor Geoffrey M Spinks work extensively on tough and stimuli-sensitive hydrogels. For instance in a report published in 2014 in the journal [\*ACS Applied\*](#)

[\*Materials & Interfaces\*](#) and Interfaces they presented an example of tough hydrogels with unique properties that enabled them to recover from large strains and absorb energy without permanent damage.

Sheets of tough hydrogels can be made to stretch over 1000 times their initial size. It's these tough hydrogels that are being used to develop hydrogel condom.



## WHAT'S SO SPECIAL ABOUT A HYDROGEL CONDOM?

A material property known as modulus (stiffness) affects tactile sensitivity, or how something feels; somewhat important in this endeavor. Hydrogels, thanks to their wet nature, have stiffness similar to body tissues and 10-100 times lower than latex rubber, which can be beneficial here. Moreover, hydrogels are self-lubricated which would eliminate problems with latex allergies and improper use of oil-based lubricants.

Hydrogels are also transparent and biocompatible, which would add to their advantage as condoms. Hydrogels can also be made to be biodegradable, which solves the problem of condom disposal.

## ARE HYDROGEL-BASED COMPONENTS EASY TO MAKE?

Well, that depends on the type of hydrogels. Most tough hydrogels require an elaborate process to make them. However, at UOW we have developed hydrogels that are tough and easy to process. Traditional manufacturing methods used for latex rubber could be used to produce hydrogel condoms. The exciting part is that there is already extensive research of using new techniques such as **3D printing** to build hydrogel-based components.



The 3D printing technology also allows for rapid prototyping. We can quickly alter the dimensions and shape based on user acceptability tests.

## WHAT ABOUT SAFETY?

Hydrogels are some of the most biocompatible materials on the planet. If you wear contact lenses, you are already wearing a type of hydrogel. Various forms of hydrogels are also found in toothpaste and shower gels, to name a couple of uses.

Tough hydrogels are also being tested for use in spinal cord regrowth and nerve and tissue engineering. Considering hydrogels are mostly made of water, it is possible to make them biodegradable, which is potentially better for the environment.

## ARE HYDROGELS A COST-EFFECTIVE ALTERNATIVE TO LATEX?

It depends on the material. Most tough hydrogels are made of materials that are more expensive than latex. But that can be due to the current production volume and the final end-users. Our aim is to select materials that are widely available, and easy to process with the same machinery used by the condom industry to minimise costs.

## WHAT HAPPENS NEXT?

It's a bit like a selection process for a football team. First, we'll line up a few candidate hydrogels and screen for a material composition best suited to making condoms. Then we'll put that material through a thorough examination of breaking strength, toughness, feel and few more technical mechanical properties that meet approved tear and burst resistance standards.

Importantly, we also have to rigorously test the permeability of the material to ensure our hydrogel condom material effectively blocks small particles that represent sperm or bacteria and viruses.

## GOING FURTHER

Our materials research is only one part of answering a very tough challenge. Once we have a material that is strong, safe and potentially more pleasurable we will need to move from a situation of "*having to*" wear a condom to "*wanting to*" use one.

To do this we are looking to have dialog with people in areas such as Sub-Saharan Africa and South-East Asia where these condoms could be used. We hope to look at social and cultural aspects for designing prototypes and eventual products. We are also looking at manufacturing, regulation, distribution and other considerations, which will be critical for success in the regions.

Overall, this is a difficult challenge but we are grateful for the opportunity to try to make a difference.



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