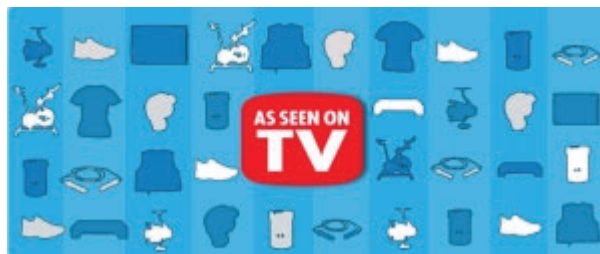


ORBEEZ

Discovering the Chemistry of Infomercials

Posted by Andrew Plotch



How annoying do you find those infomercials? If you're part of the average 99% of the population, you probably agree that we could all go on just fine without them. However, have you ever, just once, for a fraction of a second (maybe less), had a tad bit of curiosity or interest in how some of them work? A particularly interesting one to look at the science behind is the common kids' toy "Orbeez".

What ar

Vocabulary In Infomercials



e "Orbeez"?

Orbeez are developed and produced by the Maya Group Corporation. When placed in water they swell, still retaining their circular shape, and are super fun for kids to play with. The commercials show kids having a great time and making a complete mess with Orbeez flying everywhere – just waiting to be eaten by the family dog. See for yourself.

Fun right? But, what makes these toys so unique is their ability to absorb and contain water for extended periods of time without using the porosity feature of a sponge. Instead, Orbeez use chemistry! They contain what are called superabsorbent polymers, or SAPs, that absorb water and can grow to be 100-300 times their original size – all while retaining in their cute and bouncy shape.



How does this work?

The most popular superabsorbent polymer is a powder called Sodium Polyacrylate. Although that's not specifically what the Orbeez use, the process itself remains very similar. The Sodium Polyacrylate polymer, shown below in blue, contains a polar charge that allows it to combine with other liquids by forming hydrogen bonds.

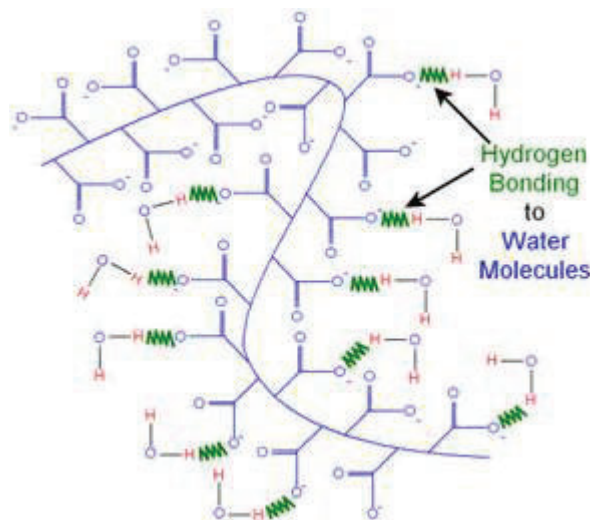
In the polymer chain, the two most important groups are the carbonyl (COOH) and sodium (Na). When in the presence of a liquid, the Sodium detaches from the carbonyl group, thus forming two ions: a carboxyl (COO^-) and a sodium ion (Na^+). The negative charge on the carboxyl groups repel each other, and as a result the polymer chain begins to unfold and expand. As the chain expands, further groups of unreacted COOH and Na on the polymer are exposed to the liquid, and continue to react. Click on the picture above for further explanation.

What is the result?

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Crosslinks between these polymer chains prevent the polymer from dissolving into the water as it is being unraveled, resulting in a gel-like consistency similar to that of Orbeez. This is because as the chains become hydrated, the cross links will restrict their free movement, thus decreasing the "randomness" or spontaneity of the reaction. The greater the number of crosslinks in the chain, the less effective the polymer will be at absorbing additional liquids because of this restricted movement and decreased free energy. However the gel produced as a result will be stronger. When the bonds are stretched to their greatest capacity, the SAP will stop growing and will no longer be able to absorb liquids. This reaction is reversible with the addition of salt, which draws the water out through the process of osmosis. Click on the image below to see the reaction.



It is also important to note that the more pure the water is, the larger the Orbeez will grow. This is because rate of this reaction is known to be dependent on the chemical composition and concentration of distilled water in the surrounding. If the concentration of deionized, pure water is high, the rate of the reaction will increase.

Why is this important?

Superabsorbent polymers are also used in many other fields today. The absorbent materials were developed in response to the need for increased field irrigation and water conservation in soil, as stated by the United States Department of Agriculture (USDA). To create the polymers, a wide range of materials were experimented with including: starch, carboxymethyl cellulose (CMC), acrylic acid, polyvinyl alcohol (PVA) and isobutylene maleic anhydride (IMA). However, the first commercial application of these polymers was in the 1970's for various disposable hygienic products such as diapers. As mentioned earlier, a variation in this technology is used in the children's toy Orbeez!

The science behind inventing the Orbeez toy, actually originated for agricultural use rather than children's amusement. Orbeez are used for **agricultural purposes** because they give off small amounts of water as time goes on. In fact, the amount of water discharged is almost perfect for watering flowers – whether they are found inside the house or in the backyard. Have you ever wondered how a golf course stays so green? Orbeez! Many golf greens have a layer of Orbeez underneath, keeping the grass that perfect green we love so much! This minimizes the need for sprinklers and prevents the grass from getting too soggy and wet. In the future, a layer of Orbeez may be developed under every lawn to keep them looking nice and well maintained.

Future research is even looking toward using absorbent polymers to change desert environments in grassy fields by placing a layer of Orbeez underneath the soil. The slow discharge of water may change the environment from a barren land to a lush green habitat. Other uses for Orbeez lie in their distinct absorbing feature. Everything from **diapers** to medicine bottles need something to soak up moisture. With super absorbent polymers like those found in Orbeez, these products can stay drier for longer.