

Silly Putty

We all remember our childhoods as a time of entertainment and toys. We remember things such as dressing up dolls in dresses made for pretend tea parties or things such as pushing a slinky down the stairs repeatedly. One toy in particular was a toy which could bounce like a ball, stretch farther than a rubber band, make any shape imaginable, and could even lift up newspaper ink. Found in a plastic egg, this rubbery little toy is known as Silly Putty. Created by James Wright, Silly Putty has gone from a needed rubber during World War II to a favorite toy of children world wide. No one would think that such an entertainment was created by simple mistake in the process of creating a synthetic rubber.

The Creation of Silly Putty

Rubber was an important resource used in World War II. Rubber was needed for the tires of tanks and trucks, gas masks, bombers, life vests, as well as many other items. Since supply was low, it was requested that U.S. citizens donate all rubber made products to help in the war. These rubber products would then be recycled into rubber necessities for the war. However, a rubber shortage still threatened the war effort.

The government then asked that scientists create an easily made synthetic rubber which could be substituted for the rubber needed. Scientists were asked to create the rubber out of ingredients that were already available and abundant in supply. All scientists nation wide joined the search for an answer to this rubber dilemma. One of the scientists who sought an answer was James Wright. Wright was working to make a synthetic rubber when he combined boric acid and silicone oil. In the test tube he discovered a glob of something very interesting. This glob had the properties of rubber yet could stretch, bounce, and be molded into various shapes. This substance was a polymer, to be more specific an elastomer. This elastomer gave the substance its properties. The new substance could also withstand extreme temperatures and lift up newspaper ink. The new discovery was amazing but had no actual value to the project Wright

was working on. He knew it had to have some type of use but couldn't think up of one so Wright sent the discovery (*shown at the right*) to scientists all over the nation but no one could come up with a practical use for the invention. Since Wright was unable to come up with any uses, the substance was put away for later. However, the substance was bought by Ruth Fallgatter in 1949. Fallgatter sold the substance in a catalog of toys as well as a major selling item in her toy store. A year later, she dropped the item from her catalog and no longer sold the substance.

A New Children's Toy



Silly Putty in its packaging

The toy was first introduced as a novelty item or an item for adults. The new substance was very popular and a huge entertainment at parties. It was at one of these parties that a man named Peter Hodgson discovered this entertainment and its potential as a major selling toy. Hodgson used a borrowed \$147 dollars and sold the toy in plastic eggs all over. He used plastic eggs because Easter was right around the corner and the eggs were in abundant supply.

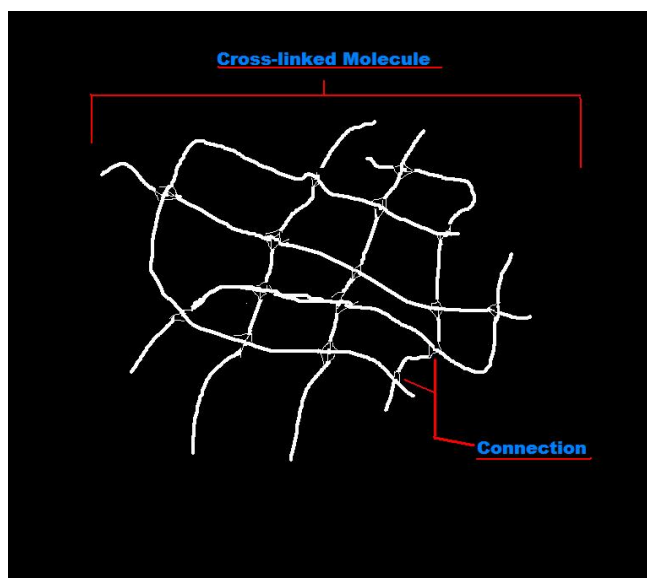
At first the name of the substance was called "Nutty Putty" but then after a while the name changed to "Silly Putty." Another thing that changed was the market to which the toy was sold. The market shifted now from adult novelties to a play thing for children. Children spent hours bending and molding, bouncing and stretching, as well as lifting up comics from newspapers and distorting the images.

New uses for the substance began to be created ironic to Wright's original attempt to finding uses. New uses included picking up dirt, getting pet hair off the couch, caulking, as well as use in the Apollo 8 mission to hold down technical equipment. Silly Putty has many valuable and silly uses but the most common use, besides being a major entertainment for children, is the substance's ability to teach students in the classroom. It is an amazing teaching tool for chemical

bonding and teaching of polymers due to its own easily identifiable and unique chemical bonding in itself. The bonds in Silly Putty make up its characteristics that can be described by anyone who has handled the substance. Polymers are used in bottles, food containers, flooring, computers, laminates, paints, and in almost every object of everyday life. Polymers are a basic compound which we use in everyday life without realizing it.

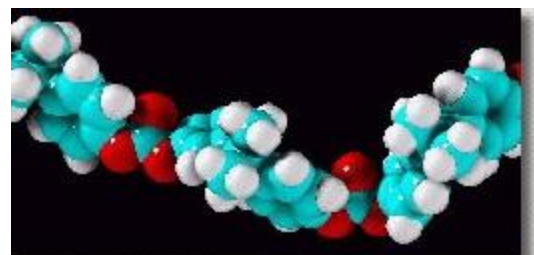
Polymers

Polymers are simply large molecules which bond together in repeating structural units to make a chain. This chain then develops properties which make up Silly Putty. Two types of polymers are plastics and elastomers which are both similar in atomic properties as they are both carbon-based in most situations. However, in plastics the molecules are tightly bonded together making the plastic hard and solid. Elastomers are used in many types of rubbers such a silly putty. In Elastomers, the molecules hold together loosely, even under pressure. However it is how the cross-linked molecule (*shown at the right*) is affected by pressure that gives Silly Putty its qualities. The links that connect the atoms in the molecule together can be easily broken and can easily reform again.



A close-up of the connections of a cross-linked molecule

Therefore, when a large amount of pressure is applied to the Silly Putty such as bouncing it against a wall, the links are disturbed and broken. This high pressure breakage happens so quick it does not allow the links to reform and the Silly Putty bounces back off the wall. When the silly putty is slowly stretched, the links in the chain molecule (*shown to the right*) are gently broken and have enough time to re-form allowing the putty to stay together as it stretches and



Chain Molecule

continues to stretch without breakage of the total substance. The cause of the breakage and reformation of links in the chain molecule is the hydrogen bonds which have the properties to do this. When the silicone oil is combined with the boric acid, these hydrogen bonds are formed creating the molecule which can break and reform. The properties of the Silly Putty really depend upon the amount of pressure or stress compressed or pulled throughout the putty which allows it to bounce or stretch. Without the breakage of the links, it would be plastic and without the ability to reform the chain would not be able to stretch and would become a liquid. Basically, Silly Putty is a polymer with covalent bonds which makes it like a liquid except for the fact that it has hydrogen bonds within the molecules making it solid.

Easy Secrets

We all wonder how we can make our own Silly Putty without knowing the major chemistry behind it. There are a few easy secrets such as recipes which are simplified for user friendly reference but with the same effect as the original recipe. Most of the Silly Putty formula is patented so specifics are usually unavailable to the general public; however, mimics are easy to make. One of the safest for children would probably be a recipe as shown below.

Silly Putty Recipe

Materials:

- **Solution of 55% Elmer's glue solution in water**
- **Solution of 16% sodium borate (Borax) in water**
- **Food coloring (optional)**
- **Ziploc Bags**

Mix together the 4 parts of the glue solution with one part of the borax solution. Add food coloring if desired and refrigerate in Ziploc bag when not in use.

Source of recipe: http://chemistry.about.com/od/everydaychemistry/a/sillyputty_2.htm

The Elmer's glue acts as the silicone oil and the Borax works as the boric acid that James Wright used in his original experiment. Other more complex experiments require more inconvenient materials to complete the whole process. However, these recipes can be easily found on the internet through simple searching. Although, the chemical process in which Silly Putty is created may be difficult to understand, Silly Putty is a relatively simple compound which can be created in anyone's kitchen using basic materials. Silly Putty is an entertaining substance which will be around for generations of fun for children all over.

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