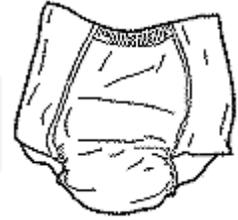


The Astronaut Diaper



Background:

The true name of NASA's astronaut diaper is the Maximum Absorbency Garment (MAG) which is a piece of clothing astronauts wear during liftoff, landing, spacewalks, and other extra-vehicular activities to absorb urine and feces. The MAG is used because astronauts cannot remove their spacesuits during long operations, so the MAG is worn in case of an emission. Three MAGs are given during space shuttle missions, one for during launch, reentry, and a spare. It is worn underneath the Liquid Cooling and Ventilation Garment (LGVG).

The MAGs are similar to adult diapers but are modified so that they are pulled up like shorts. A powdery chemical absorbent called sodium polyacrylate is incorporated into the fabric of the garment. Sodium polyacrylate can absorb around one thousand times its weight in water. The MAG absorbs the liquid and pulls it away from the skin.

In 1988, the Maximum Absorbency Garment replaced the Disposable Absorption Containment Trunk (DACT) for female astronauts. Male astronauts then followed suit, because it didn't leak and it was more comfortable. In the 1980's NASA ordered 3,200 of the diapers and a third of the supply remains as of 2007.

What's in the Diaper?

Sodium poly-a-cry-late is a white powder which rapidly absorbs water. It will instantly absorb from 500 to 1,000 times its mass of water. Distilled water renders the best results but tap water will do. One of its greatest uses is in making diapers super-absorbent.

Sodium polyacrylate is a **polymer**, meaning that it consists of chains of identical units (monomers). The monomer for sodium polyacrylate is:



Table salt, NaCl, destroys the gel and releases the water.



It brings new meaning to the term "space training."

Materials:

- Gloves, goggles and masks.
- Diapers
- Tray
- Water
- Pitcher
- Paper Towels

Demonstrations:

1. *How much water will a super-absorbent diaper hold?* (Good for both large and small groups)

Procedure: Show visitors a super absorbent diaper, a plastic glass and a pitcher of water which has been colored with yellow food coloring. Ask students to predict how many glasses of water the diaper will hold. While one student is holding the diaper open, slowly pour glasses of water into the entire length of the diaper. If you are careful, it will hold 7-10 glasses of water.

2. *What's inside of a super absorbent diaper?* (Good for small groups)

Procedure: Cut out a small square of a super absorbent and pull out some of the fibers. Shake the fibers and pull them apart allowing the sodium polyacrylate granules and fibers to fall upon the table. Brush all of the fibers into a pile. Pick up and discard the top fibers. The white granules that remain are sodium polyacrylate which makes the diaper super absorbent. Using a dropper, slowly add water to the granules and watch the gel instantly form. Show a glass of sodium polyacrylate and ask students to predict how many super absorbent diapers could be made with this amount of powder.

3. *How many drops of water can you hold on the tip of your finger?* (small groups)

Procedure: Ask visitors to guess the number of drops of water which can fit on one of their fingertips – usually only a few. Then, with a dropper show them that you can keep as many as twenty drops of water on your fingertip.

Simply place a few granules of sodium polyacrylate on your fingertip and slowly add drops of water, allowing one drop to gel before adding another.

4. *Can you invert a glass of water without the water flowing out?* (good for both large and small groups)

Procedure: Start with two beakers or two clear transparent plastic cups, one of which contains a heaping teaspoonful of sodium polyacrylate. From a pitcher pour water into the empty container. Holding both containers, one in each hand, pour the water into the one containing the sodium polyacrylate. Pour back and forth until the water completely gels. Then invert. To reverse the process and release the water, add a few heaping teaspoons of table salt to the gel and stir.

CAUTION You must wear goggles, gloves and masks when performing these experiments. Do not allow visitors to touch or smell materials. Avoid eye contact. Acute inhalation may cause mild irritation of upper respiratory tract. Dust may cause reddening, drying of affected areas with possible burning or other discomfort.

Notes: