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Which diaper is more absorbent, Huggies or Pampers?

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Summary

Our experiment's purpose is to find which newborn diaper, Huggies Little Snugglers or Pampers Swaddlers, absorbs more simulated urine (5% salt water). The Pampers diaper is composed of an average of 3.97 g of sodium polyacrylate, linked on a thin thread, and an average of 0.71 g of cotton. Huggies has an average of 1.88 g of fine powdery sodium polyacrylate and an average of 6.97 g of cotton. Huggies has about 10 times the amount of cotton that Pampers has, while Pampers has only 2 times the amount of sodium polyacrylate that Huggies has. Based on the amount of sodium polyacrylate which absorbs 30 times its own weight in urine and the amount of cotton which absorbs 27 times its own weight, we predicted that Huggies would absorb more simulated urine. We added 1 mL of 5% salt water at a time until the indicator on each diaper was full. When the indicator signaled it was full, Huggies absorbed an extra 33 mL of 5% salt water compared to Pampers. When the diaper reached its leaking point in a vertical position, Pampers absorbed an average of 83 mL before leaking and Huggies absorbed an average of 130.5 mL. This shows Huggies absorbed 48 mL more of 5% salt water than Pampers. Both diapers absorbed more than 58 mL, the amount a newborn can urinate between each feeding. We believe the amount of cotton, the powdery sodium polyacrylate, the engineering design of the diaper, and other factors made Huggies more effective. So there you go parents! Huggies is more absorbent than Pampers.

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Introduction

Diapers are worn by babies before they are toilet trained to prevent feces and urine from getting on the surrounding environment. We will do an experiment to determine which diaper can absorb more urine.

During our search for a brand name diaper, we discovered there were many, many types of diapers. To limit our scope, we decided to make criteria (1). Huggies and Pampers are used and given as samples in hospitals, suggesting that new parents buy them. On Amazon.com, we found Huggies had double the likes (4 stars and 5 stars) than neutral and dislikes (3 stars to 1 star), while Pampers had triple the amount of likes than neutral and dislikes (2, 3). We chose Huggies and Pampers, popular brand names in disposable diapers, for this experiment. Other criteria were that the diapers must be newborn size and have an indicator. This was because there was more information on newborn consumption and a single package contained more diapers for our experiment. The indicator showed us when the diaper was full. With this information, we visited Huggies' and Pampers' websites, choosing Huggies Little Snugglers and Pampers Swaddlers.

If you were to search for "Huggies versus Pampers", you would find many opinions and experiments with water. These experiments are oversimplified, due to the fact that urine contains 5% salt and impurities (4). To set our experiment apart from others and make it more realistic, we added 5% salt water to our criteria.

To calculate how much salt and distilled water were needed in a 500 mL solution of 5% salt water, we started with 5% salt water solution. This means that for every 5 g of salt there were 100 g of solution using the Mass % of solute equation:

$$\text{Mass \% of Solute} = \frac{\text{(Mass of Solute)}}{\text{(Mass of Solution)}} \times 100\% \qquad \text{(Eq 1)}$$

where Solute was Salt and Solution was Salt and Distilled Water in our case (5).

We plugged 5% Salt Water into equation 1:

$$\text{5\% Salt Water} = \frac{\text{(5 g Salt)}}{\text{(100 g Solution)}} \times 100\% \qquad \text{(Eq 2)}$$

$$= 0.05 = 5\%$$

Using equation 2 and proportions, we determined how many grams of salt were in 500 g of Solution, or χ:

$$\frac{\text{(5 g Salt)}}{\text{(100 g Solution)}} = \frac{\chi}{\text{(500 g Solution)}} \qquad \text{(Eq 3)}$$

We solved for χ where χ = how many grams of salt were in 500 g Solution.

We used cross multiplication:

$$\text{(100 g Solution)}\,\chi = \text{(5 g Salt)(500 g Solution)} \qquad \text{(Eq 4)}$$

We divided both sides by 100 g Solution:

$$\frac{\text{(}\cancel{\text{100 g Solution}}\text{)}\,\chi}{\text{(}\cancel{\text{100 g Solution}}\text{)}} = \frac{\text{(5 g Salt)(500 }\cancel{\text{g Solution}}\text{)}}{\text{(100 }\cancel{\text{g Solution}}\text{)}} \qquad \text{(Eq 5)}$$

χ = 25 g Salt needed for 500 g Solution

While we were making the 5% salt water, we only had instruments that measured volume, so we had to convert

Figure 1. Cross-section of Diaper. (**a**) Huggies' Cross-section. (**b**) Pampers' Cross-section.

weight to volume. We used the conversion factor for salt, 1 mL salt = 1.15 g salt (6).

$$(21\text{ g Salt})\frac{(1\text{ mL Salt})}{(1.15\text{ g Salt})} = 21.7\text{ mL Salt} \qquad \text{(Eq 6)}$$

≈ 22 mL Salt needed for a 500 g Solution

We calculated that we needed 22 mL Salt to make a 500 g Solution.

Since our 5% salt water solution was mainly water, we used the density of water, 1 g/cm^3 water (5). We used the conversion factor for volume, 1 cm^3 = 1 mL, to convert the same units for salt and water (5).

a	Trial 1 (g)	Trial 2 (g)	Trial 3 (g)	Average (g)
Cotton's Aluminum Tray Weight	1.42	1.42	1.29	1.38
Sodium Polyacrylate's Aluminum Tray Weight	1.1	0.76	0.71	0.86
Cotton and Tray Weights	8.46	8.1	8.49	8.35
Sodium Polyacrylate and Tray Weights	3.16	2.2	2.84	2.73
Cotton's Weight	7.04	6.68	7.2	**6.97**
Sodium Polyacrylate's Weight	2.06	1.44	2.13	**1.88**

b	Trial 1 (g)	Trial 2 (g)	Trial 3 (g)	Average (g)
Cotton's Aluminum Tray Weight	1.59	0.77	0.72	1.03
Sodium Polyacrylate's Aluminum Tray Weight	0.62	0.75	0.67	0.68
Cotton and Tray Weights	2.58	1.43	1.21	1.74
Sodium Polyacrylate and Tray Weights	5.23	4.48	4.25	4.65
Cotton's Weight	0.99	0.66	0.49	**0.71**
Sodium Polyacrylate's Weight	4.61	3.73	3.58	**3.97**

c	Huggies (g)	Pampers (g)
Average Cotton's Weight	6.97	0.71
Average Sodium Polyacrylate's Weight	1.88	3.97
Cotton Absorb (27 x Cotton's Weight)	188.2	19.2
Sodium Polyacrylate Absorb (30 x Sodium Polyacrylate's Weight)	56.4	119.1
Diaper's Total Absorption	244.6	138.3

Table 1. How Much Absorbent Materials Were in the Diapers and Predicted Amount of Water Absorbed. (**a**) The Weights of Huggies' Absorbent Materials. (**b**) The Weights of Pampers' Absorbent Materials. (**c**) Predicted Amount of Water Absorbed for Each Diaper.

$$\left[\frac{1\text{ g water}}{\cancel{1\text{ cm}^3}}\right]\left[\frac{\cancel{1\text{ cm}^3}}{1\text{ mL}}\right] = \frac{1\text{ g water}}{1\text{ mL}} \qquad \text{(Eq 7)}$$

Using proportions, we turned 1 g/1 mL water into 1 g water = 1 mL water. We assumed that 500 grams solution ≈ 500 mL solution because this solution was mainly water.

In our case, the Solution was made of Salt and Distilled Water.

500 mL Solution – 22 mL Salt = 478 mL Distilled Water needed for 500 mL Solution (Eq 8)

A baby can drink milk 6-12 times a day and produce 20-350 mL of urine per day (7, 8). Since diapers should be changed before each feeding, the diapers should absorb a minimum amount of 58 mL of urine. (350 mL of urine / 6 feedings a day = 58 mL maximum amount of urine between each feeding.)

To further examine the diaper's parts, we looked at the diaper's cross section. The basic disposable diaper has a gasket, inside membrane, cotton, sodium polyacrylate, and finally the outside cover. The gasket is used to prevent leakage in the diaper. The inside membrane is used to keep the baby from sitting on urine. The cotton and the sodium polyacrylate are the most absorbent materials in the diaper. Lastly, the outside membrane retains the contents of the diaper. To see Huggies' cross section, see **Figure 1a**. To see Pampers' cross section, see **Figure 1b**.

The most absorbent material in the diaper is sodium polyacrylate. It can absorb 800 times its own weight in distilled water, 300 times its own weight in tap water, and 30 times its own weight in urine because of salts and impurities (9). Cotton can only absorb 27 times its own weight (10).

To summarize our criteria, we used newborn size disposable diapers with indicators, Huggies Little Snugglers and Pampers Swaddlers. We tested how much simulated urine these diapers can absorb. Our simulated urine is made of 22 mL of salt added to 478 mL of distilled water to make 500 mL of 5% salt water solution. Because 58 mL is the maximum amount a newborn can urinate between each feeding, we decided that both diapers should absorb a minimum of 58 mL. We predicted the diaper with more sodium polyacrylate and cotton will absorb more simulated urine because these are the most absorbent materials in the diaper.

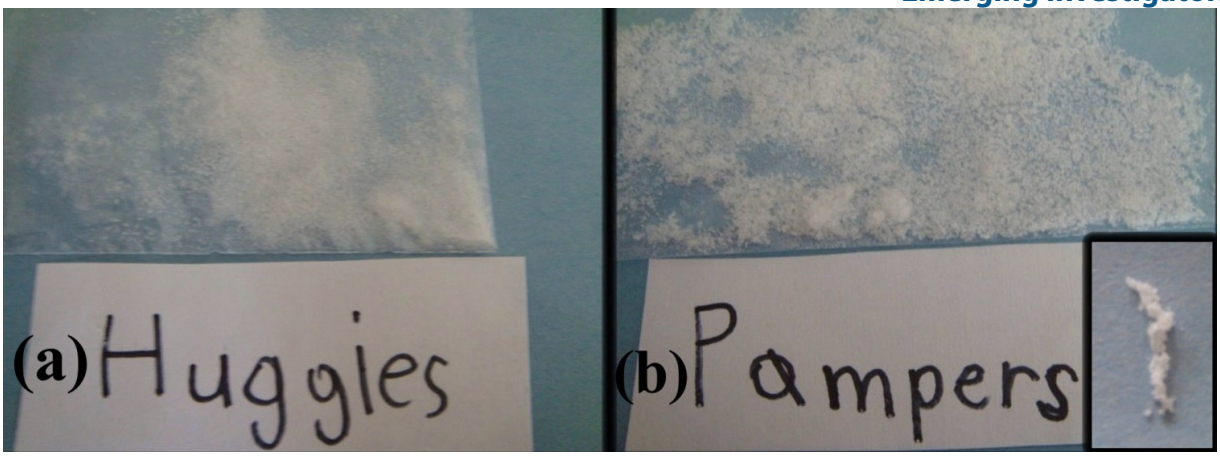

Figure 2. Sodium Polyacrylate. (**a**) Huggies' Sodium Polyacrylate. (**b**) Pampers' Sodium Polyacrylate.

Results

Part 1 - How Much Absorbent Materials Were in the Diapers and Predicted Amount of Water Absorbed.

We weighed the cotton on the balance and recorded the data. See **Table 1a** for Huggies and **Table 1b** for Pampers. Using the data from the measured cotton in **Table 1a** and **Table 1b**, we calculated the average to get **Table 1c**. For example, to get an average for Huggies' cotton, we added 7.04 g + 6.68 g + 7.2 g = 20.92 g and then divided by 3 trials = 6.97 g (**Table 1a**). Huggies contained an average of 6.97 g of cotton, while Pampers contained an average of 0.71 g of cotton (**Table 1c**). As a result, Huggies contained more cotton than Pampers.

We scraped the sodium polyacrylate from the diapers, weighed it with a balance, and recorded the data. See **Table 1a** for Huggies and **Table 1b** for Pampers. Using the data from the measured sodium polyacrylate in **Table 1a** and **Table 1b**, we calculated the average to get **Table 1c**. Huggies contained an average of 1.88 g of sodium polyacrylate, while Pampers contained an average of 3.97 g of sodium polyacrylate (**Table 1c**). We found Pampers contained more sodium polyacrylate than Huggies. The sodium polyacrylate from Huggies was fine and powdery (**Figure 2a**), while Pampers was linked by a thin thread, making it look coarse and clustered (**Figure 2b**).

In the Introduction, we researched and found that sodium polyacrylate absorbs 30 times its own weight in urine and cotton absorbs 27 times its own weight (9, 10). Knowing this, we multiplied the average sodium polyacrylate's weight by 30 and the average cotton's weight by 27. For example, to get "Cotton Absorbed" for Huggies, we multiplied 6.97 g average cotton x 27 times its own weight = 188.19 g ≈ 188.2 g cotton absorbed. To get the "Sodium Polyacrylate Absorbed" for Huggies, 1.88 g x 30 times its own weight = 56.4 g sodium polyacrylate absorbed (**Table 1c**). Then we added the two together to get the "Diaper's Total Absorption". For example, to get the diaper's total absorption for Huggies, we added 188.2 g cotton absorbed + 56.4 g sodium polyacrylate absorbed = 244.6 g.

We used proportions to compare Huggies' cotton absorbed to Pampers' cotton absorbed from **Table 1c**. (188.2 g Huggies Average Cotton) / (19.2 g Pampers' Average Cotton) = 9.8 ≈ 10 times more Huggies' cotton absorbed than Pampers. This means Huggies' cotton can absorb 10 times more than Pampers' cotton.

Using proportions, we compared Pampers' sodium polyacrylate absorbed to Huggies' sodium polyacrylate absorbed in 5% salt water from **Table 1c**. (119.1 g Pampers' Average Sodium Polyacrylate) / (56.4 g Huggies' Average Sodium Polyacrylate) = 2.1 ≈ 2 times more Pampers' sodium polyacrylate absorbed than Huggies. This means Pampers' sodium polyacrylate can absorb 2 times more than Huggies' sodium polyacrylate.

We predicted that Huggies could absorb 244.6 g of 5% salt water while Pampers could absorb 138.3 g from **Table 1c**. As a result, Huggies could absorb more than Pampers using "Diaper's Total Absorption" data.

Huggies has 10 times the amount of cotton in comparison to Pampers. Pampers has 2 times the amount of sodium polyacrylate in comparison to Huggies. We believe that having more cotton will help Huggies absorb more 5% salt water than Pampers.

Part 2 – How Much 5% Salt Water Each Diaper Absorbed When Its Indicator Was Full.

We used a Monoject 6 mL plastic syringe to add 1 mL of 5% salt water at a time on the diaper while recording the data. In **Table 2**, the data shows the amount of 5% salt water each diaper could absorb before the indicator signaled it was full. Huggies absorbed an average of 84.5 mL of 5% salt water when the indicator was full. To get an average, we added 90 mL + 94 mL + 85 mL + 69 mL and then divided by 4 trials = 84.5 mL (**Table 2**). Pampers held an average of 51.75 mL of 5% salt water

	Amount of 5% salt water absorbed when the indicator was full	
	Huggies (mL)	Pampers (mL)
Trial 1	90	50
Trial 2	94	50
Trial 3	85	62
Trial 4	69	45
Average	84.5	51.75

Table 2. How Much 5% Salt Water Each Diaper Absorbed When Its Indicator Was Full.

when the indicator was full (**Table 2**). Huggies absorbed 33 mL more 5% salt water than Pampers. (84.5 mL – 51.75 mL = 32.75 mL ≈ 33 mL.)

Part 3 – How Much 5% Salt Water Each Diaper Absorbed While Being Held in a Vertical Position When It Leaked.

We squirted 1 mL of 5% salt water at a time until the diaper leaked when held in a vertical position. We recorded how much 5% salt water was absorbed in **Table 3**. **Table 3a** is Huggies' Maximum Absorption. **Table 3b** is Pampers' Maximum Absorption. This data was determined by taking the maximum amount of 5% salt water added and subtracting the 5% salt water leaked out. For example, the maximum amount of 5% salt water added in Huggies for Trial 1 in **Table 3a** is 150 mL. This number was subtracted by 15 mL of 5% salt water that leaked out to get 135 mL absorbed 5% salt water. (150 mL – 15 mL = 135 mL. See **Table 3a**, Trial 1.) The average amount of 5% salt water absorbed by Huggies is 130.5 mL (**Table 3a**). The average amount of 5% salt water absorbed by Pampers is 83 mL (**Table 3b**). Huggies absorbed 48 mL more 5% salt water than Pampers. (130.5 mL – 83 mL = 47.5 mL ≈ 48 mL. See **Table 3**.)

We also want to note that the water on Pampers beaded up more than Huggies. When both diapers started to leak when held vertically, the outside cover still felt dry.

Discussion

The experiments showed which disposable newborn diaper, Huggies Little Snugglers or Pampers Swaddlers, absorbed more 5% salt water.

Part 1 - How Much Absorbent Materials Were in the Diapers and Predicted Amount of Water Absorbed.

Pampers' sodium polyacrylate was linked on a thin thread, making it look coarse and clustered. Huggies had fine and powdery sodium polyacrylate. Since these differences in appearance are caused by the different kinds of sodium polyacrylate, it's outside our scope. Future experiments can determine which sodium polyacrylate design is more absorbent. Because Pampers has 2 times more sodium polyacrylate than Huggies, the design of the sodium polyacrylate should not make major changes in the diaper's absorption of 5% salt water.

Based on the "Diaper's Total Absorption" from **Table 1c**, we found Huggies should absorb more than Pampers. Huggies also has 10 times the amount of cotton that Pampers has, while Pampers only has 2 times the amount of sodium polyacrylate that Huggies has. It didn't matter that Pampers has 2 times the amount of sodium polyacrylate because the extra amount of cotton was so significant that Huggies still absorbed more.

Part 2 – How Much 5% Salt Water Each Diaper Absorbed When Its Indicator Was Full.

We added one mL of 5% salt water to each diaper until the indicator was full. Huggies absorbed an average of 84.5 mL of 5% salt water, while Pampers absorbed an average of 51.75 mL of 5% salt water (**Table 2**). We discovered that Huggies absorbed about 33 mL more than Pampers. This means that Huggies absorbed more simulated urine than Pampers. One reason could be that Huggies contained significantly more cotton than Pampers.

Even though Huggies absorbed more than Pampers, it may not be more leak proof. Gaskets, engineering designs, and other factors may make the diapers more leak resistant. Other future experiments may test how leak resistant these diapers are; however, these are outside the scope of the current experiment.

Part 3 – How Much 5% Salt Water Each Diaper Absorbed While Being Held in a Vertical Position When It Leaked.

Newborns can urinate about 58 mL between feedings. Even though we found that both Huggies and Pampers can absorb more than 58 mL, both diapers still need to be changed between each feeding. Huggies absorbed 130.5 mL of 5% salt water and Pampers absorbed 83 mL of 5% salt water. See **Table 3a** for Huggies and **Table 3b** for Pampers. When the diaper reached its leaking

a	Maximum Amount of 5% Salt Water Added (mL)	5% Salt Water Leaked Out (mL)	Amount of 5% Salt Water Absorbed (mL)
Trial 1	150	15	135
Trial 2	134	8	126
Trial 3	128	7	121
Trial 4	144	4	140
Average			**130.5**

b	Maximum Amount of 5% Salt Water Added (mL)	5% Salt Water Leaked Out (mL)	Amount of 5% Salt Water Absorbed (mL)
Trial 1	85	4	81
Trial 2	95	7	88
Trial 3	86	3	83
Trial 4	83	3	80
Average			**83**

Table 3: How Much 5% Salt Water Each Diaper Absorbed While Being Held in a Vertical Position When It Leaked. (**a**) Huggies Maximum Absorption. (**b**) Pampers Maximum Absorption.

point while being held in a vertical position, we found that Huggies held about 48 mL more 5% salt water.

Our prediction was proved correct when Huggies absorbed more than Pampers. This is most likely because Huggies contained significantly more cotton.

We would like to note that some errors may originate from the accuracy of our graduated test tubes, measuring cup, graduated syringe, and balance. Other inconsistencies may come from our ability to fill and squirt each mL accurately, to tell when the diaper's indicator was full, the different timing between 1 mL of 5% salt water squirted, and/or the ability to separate the absorbent materials accurately when we were weighing them.

To conclude, all of our experiments showed Huggies Little Snugglers absorbed more than Pampers Swaddlers. Even though Pampers wasn't the more absorbent diaper, it can still absorb the maximum amount of urine expected between each feeding. Knowing this, parents don't have to worry about the diaper leaking between each feeding. With this in mind, people can still buy Pampers for the diaper's other qualities.

Methods

Part 1 - How Much Absorbent Materials Were in the Diapers and Predicted Amount of Water Absorbed.

First, we weighed the cotton's aluminum tray on the balance and recorded the weight in **Table 1a** and **Table 1b**. **Table 1a** is Huggies' experimental results. **Table 1b** is Pampers' experimental results. Second, we cut the diaper in half using a scissor. Then we peeled the cotton off the diaper and placed it in the aluminum tray. Next, we weighed the cotton with the tray and recorded the data in **Table 1a** and **Table 1b**. We repeated this with three diapers from each brand. Subtracting the tray's weight from the weight of the tray and the cotton, we got the "Cotton's Weight" and recorded it in **Table 1a** and **Table 1b**. After that, we calculated the "Average Cotton's Weight" and recorded it in **Table 1c**. When we found the average amount of cotton, we multiplied it by 27 to predict how much 5% salt water the cotton could absorb (10). We recorded this in **Table 1c** as "Cotton Absorbed".

We weighed a new empty aluminum tray for the sodium polyacrylate on a balance and recorded the weight in **Table 1a** and **Table 1b**. Then we removed the sodium polyacrylate by scraping and shaking at the diaper's sodium polyacrylate layer. After that, we measured the sodium polyacrylate in the aluminum tray on a balance and recorded the data in **Table 1a** and **Table 1b**. We repeated this with three diapers from each brand. We subtracted the "Sodium Polyacrylate's Aluminum Tray Weight" from the "Sodium Polyacrylate and Tray's Weight" to get the "Sodium Polyacrylate's Weight" and recorded it in **Table 1a** and **Table 1b**. Using the three trials of the sodium polyacrylate's weight, we calculated the average of the sodium polyacrylate and recorded it in **Table 1c**. When we got the average amount of sodium polyacrylate, we multiplied it by 30 to predict how much 5% salt water each diaper could absorb (9). We recorded this in **Table 1c** as "Sodium Polyacrylate Absorb".

To estimate the diaper's total absorption, we added the "Cotton Absorb" to the "Sodium Polyacrylate Absorb" for each diaper. We recorded the number in **Table 1c** as "Diaper's Total Absorption". Then we juxtaposed the diaper's total absorption for Huggies and Pampers to ascertain how much more 5% salt water one diaper could absorb compared to the other.

Part 2 – How Much 5% Salt Water Each Diaper Absorbed When Its Indicator Was Full.

To begin, we made the 5% salt water solution. (See Introduction for calculation.) We added 22 mL of Morton Iodized Salt using a 50 mL graduated test tube and added 478 mL of Acadia Pure Steam Distilled Water into a measuring cup. Then we mixed well. Throughout the experiment, we continued to mix the solution.

Next, we filled and squirted 5% salt water, 1 mL at a

time, near the middle-front of the diaper with a Monoject 6 mL plastic syringe. We did this until the indicator was half full. Then we had to squirt at the back of the diaper because the diaper was having trouble absorbing the 5% salt water to the back.

When the indicator was full, we recorded the amount of 5% salt water that was added to the diaper. We repeated this with four diapers from each brand. Then we calculated the average amount of 5% salt water absorbed for Huggies and Pampers when the indicator was full. This was our **Table 2**.

Part 3 – How Much 5% Salt Water Each Diaper Absorbed While Being Held in a Vertical Position When It Leaked.

We squirted 5% salt water, 1 mL at a time, until the diaper leaked. We held the diaper vertically, in between each addition of salt water, above a plastic bowl to see if it leaked. While doing this, we recorded the total amount of 5% salt water squirted until it started to leak in **Table 3** as "Maximum Amount of 5% Salt Water Added". **Table 3a** is for Huggies. **Table 3b** is for Pampers. When the diaper did leak, we held the diaper over the bowl until it stopped leaking. Then we poured the 5% salt water into a 50 mL plastic graduated test tube. We recorded the measurement in **Table 3** as "5% Salt Water Leaked Out", and subtracted it from the "Maximum Amount of 5% Salt Water Added" into the diaper. This gave the "Amount of 5% Salt Water Absorbed", and we recorded it in **Table 3**. Then we calculated the average of the "Amount of 5% Salt Water Absorbed", and we also recorded it in **Table 3**. We repeated this with four diapers from each brand.

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