

Log book

Cooling with urea

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I created the V1 Encoder, and researched about this project. I created an algorithm that turns the letters into numbers their number in the alphabet. Then I added a system to add a number to it, then use that number to get the letter. To decode, it simply takes the input number and opposites it. Tested on paper and then coded, showing it works.

Fri Jan 24 2025

I have decided to make a self cooling water bottle. I tried using TEC's(Thermoelectric Coolers) but realized the efficiency was very bad. I have now decided to use an insert which would be inserted into a Stanley, with packets containing urea dissolved in water. This would then become endothermic, being able to cool room temperature water (25°C) to cold water (9.7°C) in 5-10m depending on the outside weather conditions. It would keep water cold for 2 hours, and Stanley would keep cool for the rest.

Thu Feb 6 2025

I have decided that I want to remove the insert, so to have just small packets which would contain the solution. These would act like ice cubes and would be dropped into any water bottle. My current problem is to decide how to make the packets resealable so that the solution can be removed, and filtered for reusing.

Tue Feb 25 2025

Today I researched making a reusable cold pack vs a one-time use pack. I like the idea of reusable, for environmental reasons. There are one-time use hot and use cold packs for medical use. There are also reusable hot packs for medical use, but no cold packs that are reusable. I then researched the simple idea of boiling the urea-water mixture to reclaim the urea crystals. However this can lead to release of poisons including ammonia gas. This may not be feasible. Next steps are to try to use filtration to reclaim urea.

Wed Feb 26 2025

Today, I have researched using filtration. Filtration is quite hard, because the water would also be filtered and would leave other things on the filter. I also came across the ability to at low heat (~50°C) which **would not** cause the urea to decompose, but the water would evaporate.

Cooling calculations

Specific heat of water	J/g°C	4.18	4.18	4.18	4.18
Dissolution Enthalpy of urea	J/G	-57.8	-57.8	-57.8	-57.8
Volume of water	ml	500	250	250	500
Mass of urea	g	250	250	500	500
Starting temp	°C	25	25	25	25
Total energy absorbed		-14450	-14450	-28900	-28900
Delta T		-6.91387559808612	-13.8277511961722	-27.6555023923445	-13.8277511961722
Final temp		18.0861244019139	11.1722488038278	-2.6555023923445	11.1722488038278

Cooling calculations-1

Specific heat of water	J/ g°C	4.18	4.18	4.18
Dissolution enthalpy of urea	J/G	-57.8	-57.8	-57.8
Volume of water	ml	125	1.953125	29
Mass of urea	G	200	3.125	47
Starting temp	°C	25	25	25
Total energy absorbed		-11560	-180.625	-2716.6
Delta T		-22.1244019138756	-22.1244019138756	-22.4104933179343
Final temp		2.8755980861244	2.8755980861244	2.5895066820657

However, this process could take a few hours, and with the use of sunlight for heat, it would take approximately take several hours to a day.

Sun Mar 16 2025

Today, I am preparing for the experiment. I have bought 1 lb of urea, and did some performance calculations in a spread sheet as follows.

I have calculated that the best amounts are 250 ml of water, and 500g of urea. I have also observed that when the ml of water is equal to mass of urea, the temperature will always be 11.1722488038278 degrees celsius.

I performed my procedure, by measuring out the materials, then mixing the two and monitoring temperature. It cooled quite quickly, going from 25 deg C to 6 deg C in a matter of seconds. I was pleased with the results, and in 10 min, it only lost 1 degree , however this could be from ambient, so if it was in bottle, it probably would help to prevent this phenomenon. I am going to perform regeneration tomorrow.

Mon Mar 17, 2025

Today, I performed the second part of my experiment: Regeneration/Recovery. First I put a low amount of warm water in a turkey roaster, then put a aluminum foil disposable roaster that was a little smaller then the turkey roaster. I poured the material into the smaller container, and turned on the heat. I made sure that the water temperature of the water in the turkey roaster was at 50 degrees C. I then allowed the dater to evaporate, until I was left with just the urea in the aluminum part. I then scraped it off into a bowl. It was more like slushy ice, then how it started. I could tell there was moisture. So I put the bowl in sunlight for 1 day and 1 night. After, it was much drier and it had been a few more days and its been very dry. I was able to recover 113.5g av. I think the increase in urea weight is because of the moisture in the urea. I thought it would fully dry overnight, but when scraping from pan, it still contained some moisture. It will be left to dry another night and will hopefully dry, I may use heat to dry faster. In the fourth day, the urea weighed 102g, meaning it was probably dry. I looked at it and it looks very dry, with no dark spots from moisture.