The Effect of the Mass of Sodium Bicarbonate on Endothermic Reactions

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Medicine should be available to all. But it isn't. This is because many communities lack the resources for a medicinal cold chain, a distribution network that keeps medicine cold until it is administered. But what if cold chains could refrigerate medicine using a safe, simple, and affordable chemical reaction? This experiment investigated two such reactions: sodium bicarbonate (otherwise known as baking soda) with acetic acid and sodium bicarbonate with citric acid. These reactions were predicted to exhibit three main trends. First, as the mass of sodium bicarbonate increases, the minimum temperature of both reactions would decrease. Second, as the mass of sodium bicarbonate increases, the length of time both reactions remain at or below eight degrees Celsius would increase, with eight degrees being a standard temperature threshold for refrigerated medicine. Third, the citric acid reactions would consistently reach lower minimum temperatures than the acetic acid reactions. The data from this experiment supported these hypotheses. In fact, this experiment shows that the endothermic reaction between only forty-two grams of sodium bicarbonate and one hundred milliliters of citric acid solution can stay at or below eight degrees Celsius for almost two hours, suggesting that this reaction is a viable solution for many medicinal cold chains.

Awards Won:

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category