A novel approach for stabilizing fresh urine by calcium hydroxide addition

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Abstract

In this study, we investigated the prevention of enzymatic urea hydrolysis in fresh urine by increasing the pH with calcium hydroxide ($Ca(OH)_2$) powder. The amount of $Ca(OH)_2$ dissolving in fresh urine depends significantly on the composition of the urine. The different urine compositions used in our simulations showed that between 4.3 and 5.8 g $Ca(OH)_2$ dissolved in 1 L of urine at 25 °C. At this temperature, the pH at saturation is 12.5 and is far above the pH of 11, which we identified as the upper limit for enzymatic urea hydrolysis. However, temperature has a strong effect on the saturation pH, with higher values being achieved at lower temperatures. Based on our results, we recommend a dosage of 10 g $Ca(OH)_2$ L^{-1} of fresh urine to ensure solid $Ca(OH)_2$ always remains in the urine reactor which ensures sufficiently high pH values. Besides providing sufficient $Ca(OH)_2$, the temperature has to be kept in a certain range to prevent chemical urea hydrolysis. At temperatures below 14 °C, the saturation pH is higher than 13, which favors chemical urea hydrolysis. We chose a precautionary upper temperature of 40 °C because the rate of chemical urea hydrolysis increases at higher temperatures but this should be confirmed with kinetic studies. By considering the boundaries for pH and temperature developed in this study, urine can be stabilized effectively with $Ca(OH)_2$ thereby simplifying later treatment processes or making direct use easier.

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