Effects of Alcoholic Solvents on Urea-Biuret Morphology

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***Abstract*—Nowadays, urea is a critical ware concoction utilized primarily in the compost and plastics businesses. It is by and large created by a high weight response amongst alkali and carbon dioxide amid which little amounts of the dimer disintegration item biuret are shaped. In many procedures a crystallization step is utilized to create the last item. the purpose of this research study is to evaluate the influence of alcoholic solvents on morphological growth of urea-biuret crystal and to assess the morphological characteristics of urea-biuret crystal by using optical microscope and analytical analysis. Form the experiment, the addition of biuret in urea in different solvents and different mole ratio will effect the morphology of the urea crystals. For urea in ethanol solvent, the biuret react the fastest in changing the shape of the urea crystals as the mole ratio increases compared to in 2-propanol and iso-butanol. It showed that urea added by biuret is more soluble in ethanol compared to in 2-propanol and iso-butanol.. For analytical analysis by using X-ray Powder Diffraction (XPRD) and Differential Scanning Calorimetry (DSC) (Mettler Toledo DSC 1/700) will be discussed later.**

Keywords*— The abstract should be followed by a list of 3 to 5 key words that would be used to describe and index the research project. Key words or phrases in alphabetical order, separated by commas. Use only standard acceptable keyword that are normally used and accepted in your respective field of study.

I. INTRODUCTION

It is crucial to control the evolution of crystal morphologies by understanding crystal growth from solution. According to Lovette et al. [1], since the interaction of crystals with their environment occurs through their surface, their shape controls a wide variety of properties. This is particularly important not only in nano-technology, where shape–function relations play a key role, but also in pharmaceutical where changing the morphology of particles allows for instance for a better targeting of cancer cells [2]. Morphology of crystal is one of the important key in determined the performance and quality of the crystal product. There are few parameters that influence the crystal growth such as the supersaturation level, type of solvents, temperature, pH, hydrodynamics, cooling rates, etc. Crystallization process is controlled by these parameters and may affect the polymorphism, size and shape of the crystals. Different phase of crystal will produced different growth rate.This research project is to study the crystallization of urea in addition of biuret in difference alcoholic solvents. Next, the morphological characteristics of the crystals produced will be assessed. Urea is selected to be studied. Crystallization of urea in aqueous solution will produce needle long like shape under optical microscope. Biuret will be introduced to urea which will retard the 110 phase of urea. So the purpose of this research study is to evaluate the influence of alcoholic solvents on morphological growth of urea-biuret crystal and to assess the morphological characteristics of urea-biuret crystal by using optical microscope and analytical analysis.

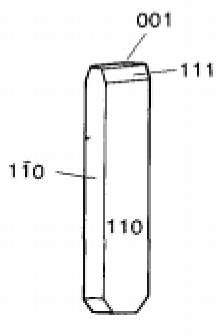


Fig. 1: Growth and habit urea crystallized from aqeous solutions [3].

II. METHODOLOGY

A. Materials

Urea, also known as carbamide, is an organic compound with the chemical formula $CO(NH_2)_2$. This amide has two ($-NH_2$) groups joined by a carbonyl (C=O) functional group. It has molecular weight of 60.06 g/mol and density of 1.32g/cm^3 with 98% purity. Its melting point is 132°C. It is a colorless, odorless solid, highly soluble in water, and practically non-toxic. It is positive uniaxial crystal belonging to the tetragonal system with the space group 42M [4]. The nitrogen atoms make it very soluble in water with a solubility of 121g urea/100g water at 25°C.

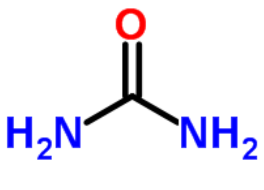


Fig. 2: Molecular structure of urea

Biuret is a concoction compound with the synthetic recipe $C_2H_5N_3O_2$. It is otherwise called carbamylurea. It is the aftereffect of buildup of two atoms of urea and is a debasement in urea-based composts. The decomposition of urea easily occurs as the melting point (132.7°C) of urea is close to its decomposition temperature (143.3°C). Biuret is additionally utilized as a non-protein nitrogen source in ruminant nourish, where it is changed over into protein by gut microorganisms [5]

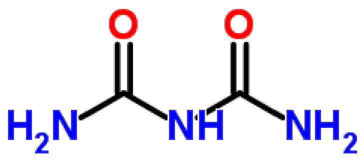


Fig. 3: Molecular structure of biuret

B. The Selection of Solvents

Ethanol (C2H6O) has molar mass of 46.07 g·mol−1 with a density of 0.7893g/cm3. It has a melting point of −114.14 ± 0.03°C. Ethanol is miscible with water and is a decent universally useful dissolvable. As indicated by Rajalakshmi et al., [6], urea has a high dissolvability in water [165 g (100 ml) - 1] and a lower solvency in ethanol [9 g (100 ml)- l].

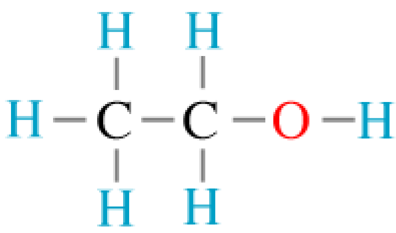


Fig. 4: Molecular structure of ethanol absolute

Iso-butanol (likewise called butyl liquor) is a four-carbon liquor with a recipe of C4H9OH, which happens in five isomeric structures, from a straight-affix essential liquor to a fanned chain tertiary liquor; [7] are a butyl or isobutyl assemble connected to a hydroxyl amass (here and there spoke to as BuOH, n-BuOH, and i-BuOH). Butanol has molar mass of 74.12 g·mol−1 with a thickness of 0.81 g cm−3. It has a melting point of −89.8 °C.

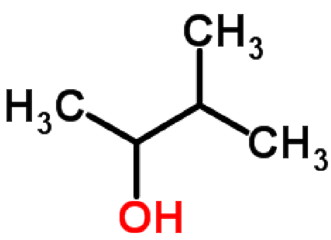


Fig. 5: Molecular structure of iso-butanol

n-Propanol, is an essential liquor with the recipe CH3CH2CH2OH (some of the time spoke to as PrOH or n-PrOH). This dismal fluid is otherwise called propan-1-ol, 1-propyl liquor, n-propyl liquor, and n-propanol. It is an isomer of isopropanol (2-propanol, isopropyl liquor). Propanol is used as a solvent and an intermediate. It shows less tendency to absorb water than lower alcohols, and has a considerably milder and more pleasant odour than higher alcohols. Propanol (C3H8O) has molar mass of 60.10 g·mol−1 with a density of 803 kg/m3.

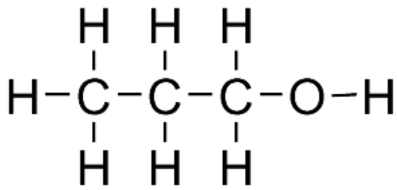


Fig. 6: Molecular structure of 2-propanol

C. *Experimental Techniques*

At first, the solubility of urea in different solvents is calculated. Then, three samples of pure area and fifteen samples of urea added by biuret with different mole ratio (1:0.5, 1:1, 1:1.5, 1:2, 1:2.5) need to be prepared. According to solubility data, 2.5g of pure urea were prepared in one 20ml vial. 15ml ethanol was used as a solvent to dissolve the samples. After that, the solutions were heated up to 65°C and were shaken by using the Orbital Shaker (Jeio Tech OS-3000) to be cooled down to 35°C for one hour at the speed of 150rpm and at cooling rate of 0.5°C/min. After that, another two sets of urea solutions were prepared and crystallized at two different solvents (2-propanol and iso-butanol). Later, another fifteen samples of urea added with 5% of biuret were prepared with different mole ratio and different solvents for each mole ratio. The crystallized samples were then filtered out from the reactor and dried in the oven at temperature of 60°C. The experiments were repeated for two times. The crystal samples were used for morphology characterization, analytical analysis and thermal analysis by using Optical Microscope, X-Ray Powder Diffraction (XRD) and Differential Scanning Calorimetry (DSC) respectively.

III. RESULTS AND DISCUSSION

A. Morphology habit using optical microscope (Meiji Techno 1559)

This part talks about the outcomes acquired from the crystallization tests for urea and the impact of biuret on the arrangement of the urea crystals. The point is to see how the expansion of biuret atoms changes the urea morphology, and furthermore how the arrangement mole ratio and alcoholic solvents impact the size of particles. The investigation of the resultant size and shape utilizing Optical microscope (Meiji Techno 1559) will be displayed and talked about.

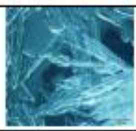
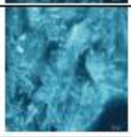
Mole Ratio (urea : biuret)	Alcoholic Solvents		
	Ethanol	2-Propanol	Iso-butanol
Pure urea			
1 : 0.5			
1 : 1			
1 : 1.5			
1 : 2			
1 : 2.5			

Table 1: Comparison morphology of urea in different mole ratio and different solvents.

Urea has been considered as it has one of a kind trademark, as it is a polar particle, with various extremity at various closures. At the point when developed from unadulterated arrangements urea takes shape as long needles with a length: expansiveness proportion that can regularly surpass 50:1 [3]. Crystallization of urea itself in ethanol dissolvable with no added substance anticipated that would deliver long needle-like crystal [8]. In any case, The nearness of biuret is known to significantly affect the propensity, delivering gems with substantially littler length:breadth proportions.

From Table 1, for pure urea in alcoholic solvents, the urea crystal produce a needle-like shape. As the mole ratio increases, the amount of biuret added in the urea increases.Thus, the shape of urea crystals become shorter in length and wider in width in all the three different solvents. For urea in ethanol solvent, the biuret react really quickly in changing the shape of the urea crystals as the mole ratio increases. However, when urea in 2-propanol and iso-butanol solvents, the biuret react slowly in changing the shape of the urea crystals especially in iso-butanol. It showed that urea added by biuret is more soluble in ethanol compared to in 2-propanol and iso-butanol..

IV. Conclusion

It can be concluded that the addition of biuret in urea in different solvents and different mole ratio will effect the morphology of the urea crystals. For analytical analysis by using X-ray Powder Diffraction (XPRD) and Differential Scanning Calorimetry (DSC) (Mettler Toledo DSC 1/700) will be discussed later.

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