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FOAM AND FOAMING SYSTEMS: A REVIEW ACROSS WIDE APPLICATIONS

Sunil Jayant Kulkarni[1]

[1]Chemical Engineering Department, Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India.

ABSTRACT

Foams are divided into closed-cell foams and open-cell foams. The gas forms discrete pockets in closed cell foams. The gas pockets connect with each other in open cell foams. Foams are very good example of dispersed media. The foams find application in firefighting systems. Bread is also one form of foam. Gas liquid foams have very high specific surface area. This property is utilized in froth flotation and foam fractionation. Studies indicate that it is important to study properties of firefighting foams for their toxicity effects. In suspension foams, investigations by researchers revealed that foam volume decreased linearly with the increase of suspension viscosity.

KEYWORDS: *Surface tension, foaming, rheology, surfactants, suspension.*

1. INTRODUCTION

Foams belong to the two-phase disperse systems consisting of dispersive media (liquid) with dispersed phase. A foam is formed by trapping pockets of gas in a liquid or solid. Foams are divided into closed-cell foams and open-cell foams. The gas forms discrete pockets in closed cell foams. The gas pockets connect with each other in open cell foams. Foams are very good example of dispersed media. The foams find application in firefighting systems. Bread is also one form of foam. Gas liquid foams have very high specific surface area. This property is utilized in froth flotation and foam fractionation. Other foam types such as ballistic foams, chaotic foams, metal foams, nanofoams, ocean foams find applications in various sectors. In current review, the research and studies carried out on foams and their application is reviewed.

2. FOAM AND FOAMING SYSTEMS: A REVIEW

Turekova and Balog carried out investigation on the environmental impacts of fire-fighting foams [1]. In their studies they considered the foams currently used in fire departments. According to them it is necessary to know physical properties. Ecotoxicological properties of modern fire-fighting foams need to be studied carefully. Bai et.al. carried out investigation on the foaming property of blast furnace slag bearing TiO_2[2]. They found that different forms of titanium compounds have different actions on the slag foaming behavior. They also observed that CaF_2 and MnO have a stronger anti-foaming effect on the slag. Denkov et.al. carried out studies on the effects of surfactant type and bubble surface mobility on foam rheological properties[3]. They reviewed large set of experimental results. Their studies indicated that two qualitatively different classes of surfactants can be clearly distinguished.

The typical synthetic surfactants with low surface modulus and fast relaxation of the surface tension after abrupt change in surface area form one class. Second class includes surfactants with high surface modulus and relatively slow relaxation of the surface tension. Lesov wt.al. investigated foams used as precursors of porous materials[4].Their focus was on Factors controlling the formation and stability. They observed existence of two regions in suspension foaminess namely good foaming and strongly suppressed foaming. Also they observed that foam volume decreased linearly with the increase of suspension viscosity. They concluded that further quantitative studies with different particles and surfactants are needed to verify the range of systems. Shey et.al. studied properties of baked starch foam with natural rubber latex[5]. Starch from surplus commodity of crops can be used as a possible replacement for non-biodegradable plastics. They made an attempt to improve water resistance of starch-based products. For this purpose, they incorporated natural rubber latex into baked starch foams based on wheat, potato, and waxy corn starches. It improves density of foam the flexibility of the product. They observed that the flexural properties of these foams were comparable with commercial products. Pisal et.al. investigated preservation of lasota virus by vacuum foam drying [6]. They studied vacuum foam drying and effect of additives. They prepared the aqueous dispersion of harvest containing sucrose or trehalose in combination with additive. They vacuum concentrated the dilute concentrations. They foamed and vacuum dried it to form a continuous structure. They found that with incorporation of N-Z-amine, the foamability of sucrose was enhanced. Antunes et.al. carried out investigation on the preparation and characterization of compression-molded montmorillonite and carbon nanofibre polypropylene foams [7]. In their work they analyzed the influence of these nanofillers on the foaming behavior. In their investigation, they carried out preparation and characterization of compression-moulded montmorillonite and carbon nanofibre polypropylene foams. They also characterized the nanocomposite foams. They compared it to the unfilled ones for dynamic-mechanical thermal behavior. They observed that the carbon nanofibre foams had an increasingly higher electrical conductivity with increasing the amount of nanofibres. Rizzi et.al. studied mechanical behavior of syntactic foam [8].The foam was made up with an epoxy resin matrix embedding randomly dispersed hollow glass microspheres. Melamine formaldehyde foam which is normally used as fire retardant was prepared and analyzed by Wang et.al. [9]. They studied properties like morphology, apparent density, fire-retardancy and mechanical property. Also the effect of different emulsifiers on foam morphology was studied by them. They found that mechanical property of foam was consistent with apparent density. Azira et.al. carried studies on anionic surfactants [10]. They studied foaming properties and effect of the isomeric distribution. They obtained two samples of anionic surfactants of sulfonate by photosulfochlorination of n-dodecane. They compared results obtained by synthetic surfactant with those obtained for an industrial sample of secondary alkanesulfonate (Hostapur 60) and to those of a commercial sample of sodium dodecylsulfate used as reference for anionic surfactants. They obtained highest foaming powder for the sample rich in primary isomers. Bamforth studied beer foam formation [11]. Increased thickness in foam hinders formation of small bubbles. Increase in localized viscosity due to polysaccharide-polypeptide complexes may be reason for this.Charteris studied high temperature resistant PLA foams[12]. He studied impregnation of the PLA beads in first machine. Second and third machines were used to pre-foam the impregnated beads and to produce moulded foam products. He used semiautomatic beads with three molds namely a fish box, a fish box lid and a small block mould. Lomakina and Mikova reviewed the factors affecting the foaming properties of egg white[13]. They found that large number of researchers have carried out investigations to find new methods to improve the volume and the stability of egg white foam. Pearcey et.al. investigated the effects of foam rolling as a recovery tool after an intense exercise protocol[14]. They assessed pressure-pain threshold, sprint time, power, and dynamic strength-endurance. They observed that foam rolling enhanced recovery and reduced physical performance decrements after the DOMS protocol. According to them, athletes seeking a recovery modality benefit from self-massage through foam rolling. Bhatt et.al. carried out investigation on metal foaming of aluminium alloys[15]. They discussed different properties and applications of various types of foams. They discussed different properties and applications of various types of foams. They concluded that Al-alloy can be used as lightweight, energy-absorption and damping structures in several industrial sectors. Mathieu et.al. investigated supercritical fluid foaming[16]. Their investigation was focused on bioresorbable ceramic–polymer composite foams obtained by supercritical fluid foaming. According to them, flexible technique enables an adequate morphology and suitable properties for bone tissue engineering. The biocompatibility studies carried out by them indicated that both neat and composite scaffolds were biocompatible. They allowed cell colonization and differentiation. Zahari et.al.

investigated potential application in thermal insulation for foamed concrete[17]. One of the materials in lightweight concrete category is foamed concrete. Important roles are played by closed cell structure in foam concrete. They, according to authors, play important roles in providing great thermal insulation performance. They evaluated the concepts of thermal insulation, the properties of foamed concrete. Their conclusion indicates that foam concrete is a great option as building insulation. Pilon carried out investigation on closed cell foams [18]. He compared numerical solutions with analytical solutions. They observed good agreement between the numerical and the theoretical solutions. According to them, it was easily possible to couple developed numerical scheme to the three-dimensional two-fluid model. Zhong et.al. investigated foam delivery technology for the distribution of remedial amendments[19]. He studied the physical aspects of the foam delivery approach. In his investigation, he studied the foam quality, the sediment permeability influence on injection pressure and liquid uptake in sediment. Also he determined possibility of water front formation during foam delivery. Also he identified techniques to monitor foam-delivery performance. Wang carried out an investigation on effects of different λ-carrageenan (λc) concentrations and pH on foaming properties of heated whey protein isolate (WPI) and λ_C soluble complex[20]. Apaydin et.al. carried out investigation on foam flow in homogeneous and heterogeneous porous media [21]. The high mobility of gas-drive fluids can be reduced by using foams. Oil and these injected fluids can have better contact due to foaming. In porous media, according to author, it is required to have a better understanding of the effect of surfactant concentration on foam flow. In homogenous sand packs, they conducted homogeneous experiments. Also they studied heterogeneity and multidimensional flow effects on foam propagation. At low concentration of surfactant, there was no significant effect. Bu after stable foam generation started sweep efficiency, pressure drop increased as surfactant concentration increased. Whitlock et.al. studied sea foam reflectance at wavelengths from 0.55 µm to 2.8 µm[22]. The data obtained by them in tests enlightened about the effects of sea foam on radiation upwelled from the ocean surface at near infrared wavelengths. They found that if the waveband is increased by nearly 100 percent, a 40 percent improvement in signal to noise characteristics of aerosol measurements over the oceans can be achieved.

3. CONCLUSION

A foam is formed by trapping pockets of gas in a liquid or solid. Foams are divided into closed-cell foams and open-cell foams. The gas forms discrete pockets in closed cell foams. The gas pockets connect with each other in open cell foams. Foams are very good example of dispersed media. The foams find application in firefighting systems. Bread is also one form of foam. Gas liquid foams have very high specific surface area. This property is utilized in froth flotation and foam fractionation. Studied indicate that it is important to study properties of firefighting foams for their toxicity effects. In suspension foams, investigations by researchers revealed that foam volume decreased linearly with the increase of suspension viscosity. Studies also reveal that carbon nanofibre foams had an increasingly higher electrical conductivity. It was also revealed that CaF_2 and MnO have a stronger anti-foaming effect on the slag. Foam plastics have good mechanical properties. Thus foaming characteristics can be utilized in various food, thermal, reactor and separation operations.

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