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(Research Article)

# A research article on polymeric surfactant and its applications

Tejas Joshi *

*Department of Chemistry, UGC NON-SAP & DST-FIST Sponsored Department, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar, India.*

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## Abstract

Polymeric surfactants represent a distinctive class of amphiphilic compounds that combine the versatility of polymers with the surfactant properties crucial for interfacial phenomena. This research article will focus on the basis of polymeric surfactants and their applications in various domains. Characterisation techniques, including spectroscopy, microscopy, and rheology, are employed to elucidate polymeric surfactants' structural features and self-assembly behaviour. Understanding these characteristics is pivotal for optimising their performance in diverse applications. The applications of polymeric surfactants span a broad spectrum, focusing on their use in emulsion polymerisation, drug delivery, enhanced oil recovery, and environmental remediation. Their unique structure imparts advantages such as improved stability, controlled release, and enhanced efficiency in various processes.

**Keywords:** Polymeric surfactant; CMC; Micelles; Block copolymer

## 1. Introduction

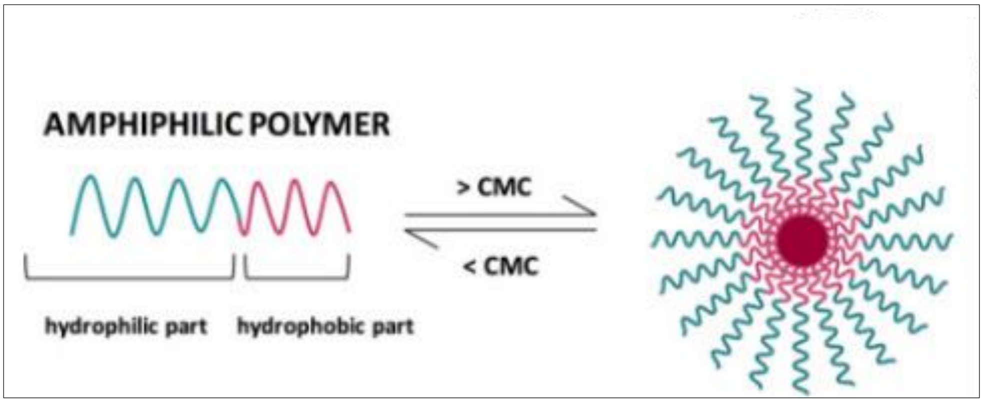


**Figure 1** Formation of polymer micelle above critical micelle concentration (CMC)

Polymeric surfactants are a class of polymers that exhibit amphiphilic qualities and can micelles (surfactant properties). Polymeric surfactants are distinguished from standard small molecule surfactants by the presence of polymer chains in their structure. The polymer chains, which might be synthetic or biologically generated, contribute capabilities and qualities to the surfactant. It is typically challenging to extract polymeric surfactants from natural sources, and their structures and compositions may vary depending on the source; consequently, most systems examined and published in the scientific literature are synthetic. Based on their molecular structure, polymeric surfactants are divided into two

* Corresponding author: Tejas Joshi

types: "polysoaps," whose repeat unit is amphiphilic on its own, and amphiphilic block and graft copolymers, also known as "macro-surfactants," whose total macromolecule is an amphiphile. [1-3] The schematic representation is shown in Figure 1.

## 2. Block Polymers

Block copolymers (BCs) are a type of polymer in which each molecule is made up of two or more portions of simple polymers arranged in certain ways. Polymeric surfactants have piqued the interest of researchers due to their vast range of uses as suspension and emulsion stabilisers. Various polymeric surfactants have been presented, and they are distinguished by special commercial names. [(Like Hypermers by Impirical Chemical Industries (ICI). [4] Block copolymers can be put into three groups based on how many blocks they have: diblock (AB type), triblock (ABA or ABC type, etc.), and multi-block. A polymer can be either straight, with branches, or crosslinked. It's important to know which type a polymer is in order to figure out how it acts in solution. [5,6] There is a covalent bond between the monomer blocks. Depending on how many blocks are present and how they are arranged in the structure, BCs are classified according to their number. For instance, BCs with two blocks are known as diblock copolymers AB; those with three blocks are triblock copolymers and those with multiple blocks are called fragmented or multi-block copolymers. Nonlinear BCs are often called star-block copolymers. Figure 2 shows a simplified view of the different kinds of BCs. The ABA linear triblock copolymer is made up of two different kinds of monomers. The linear triblock copolymer, or terpolymer, of ABC, is made up of three different monomers. There are many different ways that different BCs could be made. In this way, it is possible to make polymers that are diblock (A-B), triblock (A-B-A and B-A-B), and multi-block. BCs have unique molecular properties that are similar to those of surfactants. This means that they absorb onto surfaces and form micelles on their own in solutions. The fact that BCs in solution are both water and oil-soluble helps a lot with the packaging of drug delivery at the target. Self-assembly of BCs led to different nanoscale shapes that were used in fine lithography and the creation of permeable materials. [7,8]

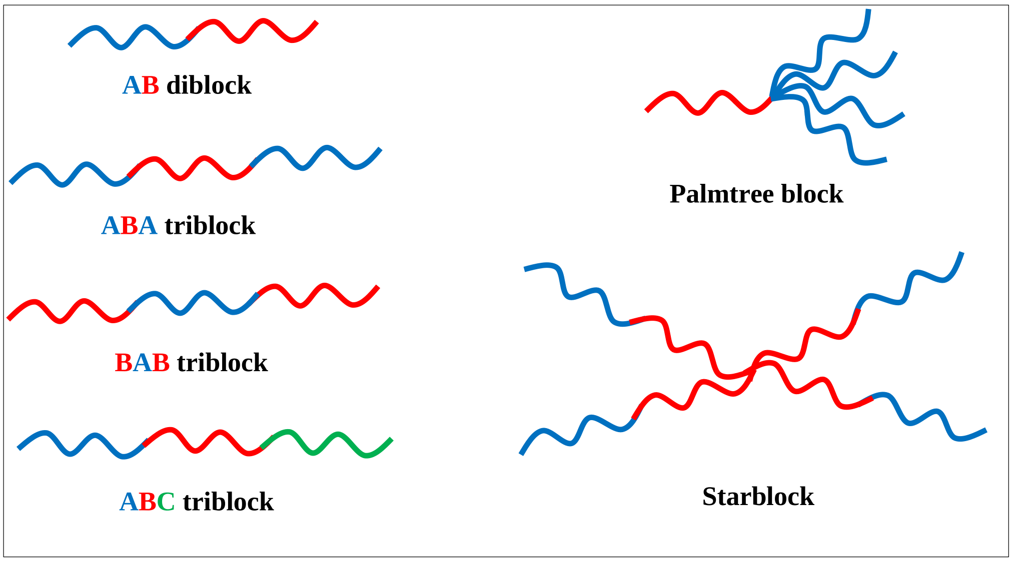


**Figure 2** Schematic illustration of different types of block copolymers

## 3. Pluronics®

Water-soluble block copolymers (BCs), which contain both aquaphilic and aquaphobic moieties within them, are a specific kind of polymeric surfactant. It shapes the micelles/aggregates similarly to a typical surfactant. A large class of nonionic surfactants comprises the block copolymers of ethylene oxide and propylene oxide (EO-PO). These copolymers typically have amphiphilic characteristics and are water-soluble. Poly(ethylene oxide), poly(propylene oxide), and poly(ethylene oxide) (PEO-PPO-PEO) are commercially available linear triblock copolymers. [9]

Pluronic® is the brand name these copolymers are sold under, according to BASF. Pluronics are available in a wide range of EO/PO configurations, with molecular weights ranging from 2000 to 20,000 g/mol and PEO concentrations ranging from 10 to 80 weight percent. They are also referred to as polymersomes or polaxomers. [10] The solubility of the PPO blocks significantly drops at higher temperatures and above a specific fixed temperature is called the "*critical micelle temperature (CMT).*" Figure 3 represents the formation of BCs.

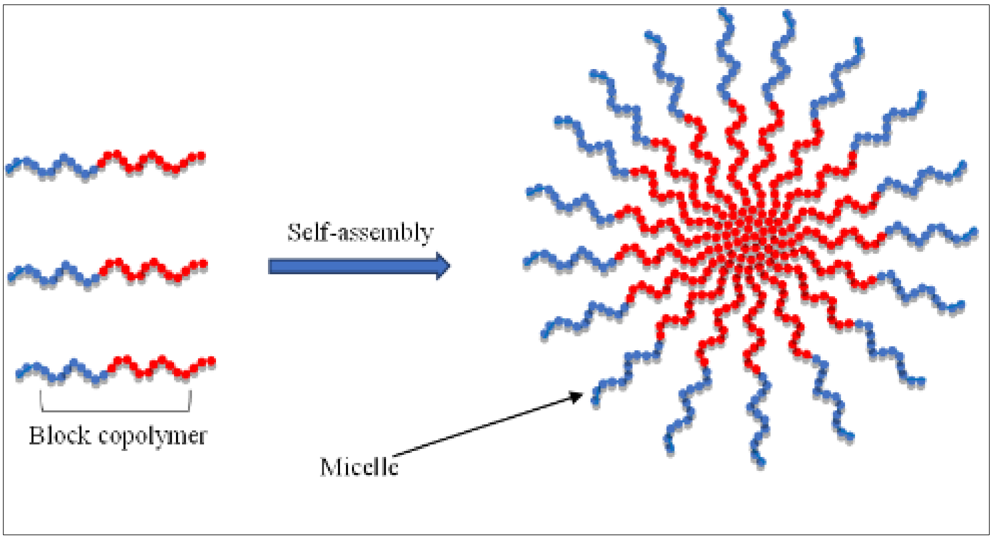


**Figure 3** Schematic illustration of self-assembly of BCs

## 4. Applications of Polymers

Water-soluble polymers have far and wide applications in different fields, such as water treatment processes, emulsion adjustment, particularly in emulsion paints, cosmetics such as beauty care products, advanced oil recovery, drug definitions, and so on. The potential and existing applications in many different fields, including coatings, nanotechnology, water purification, emulsion polymerisations, medicine, cosmetic, biotechnology, pharmacology, agriculture, electronics, and enhanced oil recovery, to name a few. Polymeric surfactants have a wide range of applications, including personal care, pharmaceuticals, agrochemicals, paints & coatings, oil & gas, and personal care products. In personal care products, they serve as stabilisers, emulsifiers, and thickening agents. They can increase the solubility and bioavailability of drugs in pharmaceutical formulations. Polymeric surfactants in agrochemicals can improve the effectiveness of insecticides and herbicides. They offer better coating and dispersion qualities in paints and coatings. They are employed in the oil and gas industry as drilling fluid additives and for improved oil recovery. [11-14]

## 5. Conclusion

In conclusion, the exploration of polymeric surfactants and their applications provides a platform for innovative advancements in materials science and technology. The versatility of these compounds opens avenues for sustainable solutions and novel applications, underscoring their significance in the contemporary landscape of scientific research and industrial processes.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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