# Influence of methyl methacrylate content in electrostatic stability of poly (methyl methacrylate-butyl acrylate) water-based latex

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**Abstract**
Emulsion polymerization of methyl methacrylate (MMA) and butyl acrylate (BA) is a significant process for producing water-based latexes. In the present study, the effect of methyl methacrylate percentage in the formulation of MMA and BA emulsion polymerization on the electrostatic stability of obtained latexes was investigated. The increase of MMA in formulation (from 35% to 50%) caused an increase in zeta potential and average particles mobility (from -41.1 mV to -31.1 mV and from -3.04 µm/s/V/cm to -2.48 µm/s/V/cm, respectively).
**Keywords: Emulsion polymerization, Methyl methacrylate, Butyl acrylate, Zeta potential, Particle mobility.**

## 1. Introduction

The semi-batch emulsion polymerization is an important reaction for the production of appropriate latexes for the paints and coatings industries. Acrylic latexes provide a wide range of properties such as gloss, colloidal stability, solvent resistance, elasticity, and compatibility [1]. The shelf-life of colloidal dispersions is a significant issue for successful product development. Latex products should have a shelf life of a minimum of numerous months in most applications [2]. Zeta potential and average particle mobility are two factors to estimate the electrophoretic stability and shelf-life of obtained latexes. In this work effect of MMA percentage in emulsion polymerization formulation of MMA and BA on zeta potential and mobility of latex particles was investigated.

## 2. Experimental

### 1-2. Materials

Butyl acrylate (BA) and methyl methacrylate (MMA) were purchased from Petro Chem Co, Dubai, UAE. Ammonium persulfate (APS, Aldrich, Lancaster, UK), dioctyl sulfosuccinate (DOSS, Sigma Aldrich, Saint Louis, USA), nonylphenol ethoxylate (K20, Kimiagaran Emrooz Chemical Industries Co, Arak Iran) and sodium hydrogen carbonate ($NaHCO_3$, Merck, Germany), used as the initiator, anionic surfactant, nonionic surfactant, and buffer, respectively.

### 2-2. Synthesis of MMA-BA latexes

The emulsion polymerization process was conducted in a four-necked glass reactor equipped with a mechanical stirrer, reflux condenser, thermometer, and dropping funnel. Deionized water, emulsifier and buffer were transferred to the reactor as an initial charge and agitated for 30 minutes. Then, about 5% of the monomer mixture was added to the reactor and agitation continued for a further 30 minutes. As the temperature raised to 70 °C, about 30% of initiator solution was added and about 15 minutes after that, the remaining monomers mixture fed dropwise within 3.5 h with about constant rate. When addition of monomer was completed, temperature was increased to 80 °C and condition was kept for a determinate time. The emulsion polymerization recipe is shown in Table 1.

**Table 1. The emulsion polymerization recipe.**

| Materials | MMA* | BA | AA | APS | water | DOSS | K20 | $NaHCO_3$ |
|---|---|---|---|---|---|---|---|---|
| Initial charge (g) | Various | 5.5 | 0.25 | 0.25 | 300 | 4.5 | 8 | 0.6 |
| Feeding (g) | Various | 107 | 4.75 | 0.55 | 10 | - | - | - |

*MMA weights are various from 35 to 50 w% (based on total monomers weight).

## 3. Result and Discussion

### 1-3. Effect of MMA percentage on latex stability

Zeta potential and mobility of latex particles are two measures to indicate the stability of latex against coagulation. The high numerical value of zeta potential and the mobility of latex particles indicate the high level of electrostatic stability of latexes [3]. In MMA-BA latexes, with the increase in the percentage of MMA in the feed, the numerical value of the zeta potential and the mobility of the latex particles increased with a slight slope (figure 1 and Table 2). It`s worth mentioning that measurements were performed in basic conditions (pH=8) and due to the dependence of zeta potential to pH, more electrostatic stability of the latexes that are richer with MMA can be related to the higher rate of MMA hydrolysis in basic conditions. Hydrolysis of the MMA parts in polymer chains leads to the formation of carboxylate groups and increases the surface charge of particles and as a result, the Brownian motion of particles increases [4].

**Table 2. Colloidal properties of the latexes.**

| MMA% | Monomer conversion (%) | Average zeta potential (mV) | Average particles mobility (µm/s/V/cm) |
|---|---|---|---|
| 35 | 96.4 | -41.1 | -3.04 |
| 40 | 97.9 | -40.5 | -3.00 |
| 45 | 99.3 | -39.8 | -2.97 |
| 50 | 98.8 | -31.1 | -2.48 |

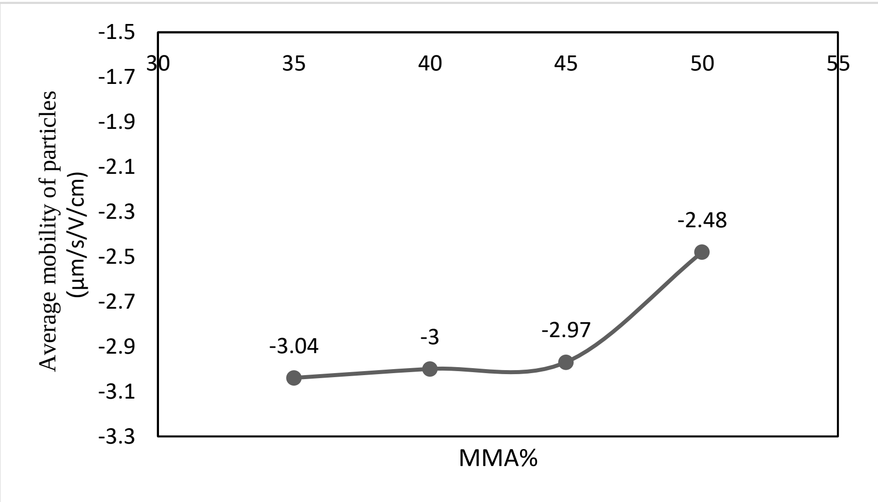


**Figure 1. Effect of MMA% on average mobility of the latex particle.**

## 3. CONCLUSIONS

Influence of MMA content in emulsion copolymerization of MMA and BA on zeta potential and average mobility of latexes particle was investigated. As MMA percentage in copolymers structure was increased (from 35% to 50%), zeta potential and average mobility of latex particles were increased (from -41.1 mV to -31.1 mV and from -3.04 µm/s/V/cm to -2.48 µm/s/V/cm, respectively). It was concluded that increasing MMA in MMA-BA copolymer structure leads to increase the latexes electrostatic stability.

## 4. ACKNOWLEDGMENT

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