**Research Highlight**

1. ATPS was prepared by a mixture of for poly (ethylene glycol) (PEG) (300, 400 and 600) + zinc sulfate/magnesium sulfate/aluminum sulfate aqueous two-phase systems (ATPS's) at 25 °C.

2. The density and refractive indices were employed as the physical properties to obtain the phase composition and the tie-lines’ ends.

3. The heterogeneous region for each system increases with PEG molecular weight.

4. The effect of salting out of cations increases as follows: > >

5. The effective excluded volume increases with the PEG molecular weight.