In this study, microencapsulated n-eicosane with poly(methylmethacrylate-co-2-hydroxy ethyl methacrylate) p(MMA-co-HEMA) shell as composite thermal energy storage material was prepared using emulsion polymerization method. Microcapsules were produced for usage as an additive in textiles to develop thermal comfort property. In the composite thermal energy storage material, n-eicosane was used as the core and poly(methylmethacrylate-co-2-hydroxy ethyl methacrylate) acted as the shell material which provided better adherence or functional surface to textile materials by physical interactions or chemical bonds respectively. Fourier transformation infrared spectroscope (FT-IR) and polarized light microscope analysis were used to determine chemical structure and microstructure of microencapsulated n-eicosane. The thermal properties and thermal stability were investigated by a differential scanning calorimeter (DSC) and a thermogravimetric analyzer (TGA). The mean particle size and size distribution was tested by a particle sizer instrument. The FT-IR results showed that n-eicosane was encapsulated in the shell successfully. The DSC results indicated that the microencapsulated n-eicosane solidifies at 34.6-35.3 °C with a latent heat of 68.1-93.0 J/g and melts at 34.8-35.6 °C with a latent heat of 75.9-97.0 J/g. The TGA results presented that the p(MMA-co-HEMA) shells can improve the thermal stability of the microencapsulated n-eicosane as composite thermal energy storage material.