The composite industry looks toward a new material system (resins) based on thermoplastic polymers for the vacuum infusion process, similar to the infusion process using thermosetting polymers. A large number of thermoplastics are available in the market with a variety of properties suitable for different engineering applications, and few of those are available in a not yet polymerised form suitable for resin infusion. The proper selection of a new resin system among these thermoplastic polymers is a concern for manufactures in the current scenario and a special mathematical tool would be beneficial. In this paper, the authors introduce a new decision making tool for resin selection based on significant attributes. This article provides a broad overview of suitable thermoplastic material systems for vacuum infusion process available in today’s market. An illustrative example—resin selection for vacuum infused of a wind turbine blade—is shown to demonstrate the intricacies involved in the proposed methodology for resin selection.