

vapor rate, antibacterial properties, and wound-healing rate with a concentration of 4% only. When this developed wound-dressing material has been used in wound care, due to the higher water absorption capacity after 30 minutes of soaking in water, all the spirulina extract has been released from the wound dressing. Figure 9.4 confirmed the suitability of the spirulina/alginate/PCL nanofiber-based wound-dressing material compared to pure PCL, spirulina/PVA, and PCL/alginate-based materials.

9.4.1.6 *Alginate Hydrogel-Based Wound Dressing*

Hydrogels are three-dimensionally cross-linked structures made of hydrophilic polymers with high water contents [50]. They can be prepared from natural as well as synthetic polymers. Hydrogel is mainly categorized into two types, i.e., “physical hydrogel” and “chemical hydrogel.” When a polyelectrolyte polymer interacts with multivalent ions-based opposite charges, then physical hydrogel will be formed. For instance, calcium alginate is one of the physical hydrogels. Chemical hydrogel will form when polymer network structure cross-linked covalently [51–53]. The physicochemical properties of the resultant hydrogels depend upon the cross-linking density, molecular weight, and chemical compositions of the polymer [54]. Various hydrophilic polymers from which a hydrogel can be synthesized are shown in Table 9.2. The polysaccharides-based polyanionic biopolymer alginate has been used tremendously in biomedical applications, mainly in wound care dressing, because of its different favorable properties, which are already mentioned in Section 9.3. Alginate can be used in different forms like direct polymer, fiber, and hydrogel. Among the different forms of alginate, hydrogel-based alginate has wide application in wound care dressing. Alginate hydrogel has been formed by cross-linking of alginate polymer with cross-linking agents like acrylic acid, acrylamide, methacrylamide, etc. It is known that alginate polymer consists of two types of acid block, i.e., alpha-L-guluronate (G block) and beta-D-mannuronate (M block). The G block is mainly cross-linked with divalent cations (e.g., Ca⁺) to form the alginate hydrogel material. Therefore, the length and molecular weight of the G block have great influence on the resultant hydrogel properties [55]. Alginate hydrogel-based wound-dressing material has higher biocompatibility, hydrophilicity, fast blood clotting rate, and high porosity. Due to the above-mentioned advantageous properties of alginate hydrogel-based wound dressing, it can be used highly in wound-healing application. Alginate hydrogel can also be used in cell transplantation in tissue engineering because of its mimicking characteristics with the extracellular membranes of living tissues [56]. Furthermore, in order to improve