Ring-opening polymerization of ε-caprolactone in supercritical carbon dioxide medium using Novozyme 435 as catalyst can provide residue free polycaprolactone. Therefore, it is an attractive process for the pharmaceutical and food industry to produce scaffolds and encapsulated compounds. However, Novozyme 435 is a high cost enzyme and the feasibility of this process depends on the possibility of the reuse of the enzyme. The reuse of Novozyme for polycaprolactone production was studied using supercritical carbon dioxide at 120 bar, solvent to monomer mass ratio of 1:2, temperature of 65 °C, 12 h of reaction and 3 wt% of enzyme in a variable volume reactor. The reaction yield remained approximately constant in the first two cycles and then decreased from 64 wt% to 37 wt%, remaining at 38%-37% for the two following cycles. Throughout the reuse cycles, it was observed that the basis on which the enzyme is immobilized, a macroporous resin, gradually collapses. This may have happened due to the abrasion of the magnetic stirrer on enzyme particles. The number average molecular weight (M<sub>n</sub>) obtained for the first cycle was 12,300 Da decreasing constantly to 7,800 Da in the fifth cycle. The weight-average molecular weight (M<sub>w</sub>) obtained for the first cycle was 19,000 Da decreasing constantly to 7,800 Da at the fifth cycle. The polydispersity index ranged from 1.5 to 1.3, from the first to the fifth cycle. The decrease of yield and molecular masses may be consequence of the interaction between enzyme and carbon dioxide that removes water from enzyme.