TiO₂ nanoparticle was synthesized from precursor TiCl₃ with NH₄OH and HCl solution by using co-precipitation method. Annealing was given at temperatures of 200 – 1000°C for times between 2 and 10 hours. The powder obtained was characterized by means of X-ray Diffraction (XRD) and Brunauer-Emmet-Teller (BET). The results indicate that the obtained phase for all conditions is anatase at temperatures of 200 – 800°C. 100% rutile phase was obtained at 1000°C. Calculated activation energy are $E_a(k_{2\text{hours}}) = 3.722 \text{ kJ/mol}$, $E_a(k_{4\text{hours}}) = 5.073 \text{ kJ/mol}$, and $E_a(k_{10\text{hours}}) = 2.024 \text{ kJ/mol}$, while for overall activation energy is 6.025 kJ/mol. As the rutile phase became dominant, the pore volume decreased significantly. In term of agglomeration ration, it is found that annealing at 400°C for times up to 4 hours leads to high agglomeration ratio, i.e. 899.4145 for particle size that transformation from anatase to rutile is about to take place. Reaction with lower purity NH₄OH results in a faster anatase particle growth with particle size difference of 30 – 60 nm compared to those of using high purity NH₄OH.

Keywords: titanium dioxide, co-precipitation method, x-ray diffraction, pore volume, agglomeration