

DISSERTATION INFORMATION

Title: **Study on the chlorination technology to produce TiCl_4 from Vietnamese titania slag.**

Major: **Chemical Engineering**

Major code: **62520301**

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1. Abstract

Titanium and its compounds are important in many industrial applications. Vietnam has exported low-grade titania slag with low benefit. To increase the value of Vietnamese titania slag, this material needs to be processed into high-grade titanium dioxide and titanium metal. For this purpose, the titanium dioxide in titania slag must firstly be converted to titanium tetrachloride – an intermediate compound with the high capability of purification.

Results of both titania slag conversion by carbo-chlorination and titanium tetrachloride purification are presented in this thesis. The effects of temperature and partial pressure of chlorine on carbo-chlorination were investigated and modeled. It is found that titanium dioxide conversion was the highest at temperature of 950 °C and input partial pressure of chlorine of 0.3 at. The application of distillation technique for titanium tetrachloride purification was also studied and modified. The results show that a titanium tetrachloride product of sufficient quality for titanium dioxide pigment production can be obtained through a two-stage purification process: (1) first, simple distillation, and (2) second, combined distillation and chemical treatment. Obtained parameters from experiments were applied for systems operation in pilot scale. Successful production of high-grade titanium tetrachloride from Vietnamese titania slag in a pilot plant explores the prospect of improving the value of Vietnamese titania slag on an industrial scale.

2. Major contribution of this study

- 1) The study found out the conditions for the preparation of the raw materials, the temperature and the partial pressure of Cl_2 in the carbon-chlorination process to maximize the conversion of TiO_2 in the Vietnamese titanium slag into TiCl_4 .
- 2) A mathematical model has been built to describe the kinetics of the carbon-chlorination reaction of cylindrical pellets and has been verified with experimental results. From analytical solution, the distribution of Cl_2 concentration in the pellets according to the reaction time was simulated. The kinetic equation for the carbon-chlorination reaction of TiO_2 in the pellets under the influence of diffusion of Cl_2 into the pellets and the reaction was established.
- 3) This work has also determined the procedures and operating parameters of TiCl_4 purification.
- 4) The operation of batch-mode distillation column in pilot scale was modeled and simulated. Accordingly, the influence of different operating parameters (bottom heating power, initial concentration, cooling airflow and working pressure) on the separating efficiency of this distillation column has been explored.

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