

## KINETIC INVESTIGATION OF PROPANE DISAPPEARANCE AND PROPENE FORMATION IN PROPANE OXIDATION ON DILUTED AND LEACHED MoVTeNb CATALYST

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### ABSTRACT

Reaction kinetics for the oxidation of propane over diluted-leached MoVTeNb is described. This paper focused on the study of products selectivity profile and determination of the orders of propane disappearance and propene formation. The result shows that selective oxidation of propane to propene over this catalyst follows Langmuir-Hinshelwood mechanism. The disappearance of propane is first order with respect to hydrocarbon partial order (0.21) with respect to oxygen. The propene formation is first order with respect to hydrocarbon and depending on oxygen concentration.

**Keywords:** propane oxidation, propane disappearance, propene formation, kinetic, reaction order

### INTRODUCTION

Nowadays, most industrial processes produce acrylic acid via a two-step oxidation reaction. This two steps including propene oxidation over multi-component Mo-Bi-Co-Fe-based oxide catalysts at 320-330 °C to make an intermediate compound, acrolein, which can be further oxidized at 210-255 °C over Mo-V-based oxide catalysts to form more acrylic acid. Overall selectivities to acrylic acid based on propene of 85-90% are obtained at conversions above 95% [1]. Currently, the development of acrylic acid production from one-step oxidation of propane has been conducted. The economic importance of this possibility and the successful manufacture of maleic anhydride by selective oxidation of n-butane have stimulated various researches. In parallel, investigations on catalytic oxidative dehydrogenation of propane have been undertaken since this route is expected to lead to lower costs of propylene production as compared to the non-catalytic and non-oxidative processes [2]. In addition, the behaviour of light alkanes (C<sub>1</sub>-C<sub>6</sub>) in catalytic partial oxidation reactions is different from the one to another [3-7].

The involvement of selective oxidation reaction of propane to acrylic acid has been heavily studied [8-10]. Partial oxidation of propane to acrylic acid over vanadium pyrophosphate (VPO) catalysts [11-12] and heteropolyacids [13-14] has been reported. In the last years the use of multi-component oxidic catalysts based on molybdenum, vanadium, niobium and tellurium seems to lead to a major breakthrough and promising developments [15]. So far the open literature is mainly restricted to the study of catalyst preparation, its structure and the comparison with other catalytically

active systems [9,15-17]. The selective oxidation reaction of propane is difficult to perform for a very low yield since the product is easily further oxidized. Detailed expression for apparent rate (kinetics) permit the chemical engineer and chemist to make rigorous extrapolation of experimental results to industrial scale and to identify adequate experimental conditions.

It is shown in the literature that the reaction network and products distribution are very sensitive toward the catalyst used. Significant differences in reaction pathways are observed when the reactions are carried out over, metal oxides catalysts [18], Mo-V-Nb catalysts [10], and Mo-V-Te-Nb catalysts [9]. In a previous article, it has been described the reaction kinetics and mechanism of propane partial oxidation to acrylic acid on diluted MoVTeNbOx mixed-oxide catalysts using high-throughput system (nanoreactor) [19]. This article more focus and deals with similar reaction oxidation over diluted and leached MoVTeNbOx mixed-oxide catalysts. The paper is divided into two parts. Part one is focused on the profile of products selectivity, the rate of propane disappearance and the rate of propene formation.

### EXPERIMENTAL SECTION

#### Materials

Ammonium Heptamolybdate tetrahydrat (Merck), Ammonium Metavanadate (Riedel-de Haen), Telluric acid (Aldrich), Niobium Ammonium Oxalate (Aldrich), Water, Nitrogen, Propane, Oxygen.

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