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Flow chart of methanol in China

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ABSTRACT

Methanol is considered as one of the potential materials for fossil-based fuel since its available applications in the fields of fuel and chemical materials. China has become the biggest methanol production country since 2006, so analyzing the consumption, production and transportation of methanol in China has great importance. In the present paper, the flow chart of methanol from production to consumption in China has been systematically described. Chinese industry and statistics data are introduced to analyze and discuss the total and segmental methanol amount in both production and consumption. In China, most of the methanol is primarily consumed in the synthesis of formaldehyde, alternative fuels, and acetic acid synthesis with the corresponding percentage of 35%, 33%, and 8%. Synthesis approaches from methanol to these downstream products are analyzed and the variation tendencies of the demand on these downstream products are predicted. In 2011, about 22.27 million t methanol was generated on-site, in which, 63.7%, 23.0% and 11.3% are produced by coal, natural gas and coke-oven gas respectively. Energy flows of each synthesis process based on these feedstocks are given and the energy efficiency are calculated and compared. As for the transportation, approximately 82.6% of methanol is relied on overland freight, 9% by marine and the rest 8.4% by train.

Contents

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1. Introduction

The modern era is in urgent need of alternative energies for its sustainable development under the serious threatening of fossil-based materials' depletion [1–5]. Nuclear energy, wind energy, solar energy, hydro-energy, bio-energy, hydrogen energy, and the transformed electrical energy are considered promising alternative energies in the future, but the fossil-based materials will not completely quit the stage of history since they are the utmost important raw materials in various chemical industries. As well-known, methanol is a promising alternative fuel especially for transportation field [6,7]. Meanwhile, it is an utmost important raw materials in chemical industries. Therefore, making investigations on the production and application of methanol have attracted more and more scientists since its available applications in the fields of fuel and chemical materials, and making plans and projects on the production and application of methanol have attracted more and more authorities[8–10].

In China, the methanol energy industry is established at the medium-20 century, and the production capacity on methanol is increasing in a vibrating tendency and has been increased by approximately 16 times during the past 16 years (from 1995 to 2011) (as shown in Fig. 1) [11]. Over the same period, the mean increase extent on the production capacity of methanol throughout the whole world is just triple. Fig. 2 shows the corresponding production capacity increment in China and the world. From the beginning of 2002, China's methanol industry strode into a fast development period and the annual increment outclass the worldwide level from then on. Thus, the development of China's methanol energy industry can be considered as a typical example in both production capacity scale and production capacity increment. Due to its fast increment, China's sharing ratio on the annual production capacity of methanol is continuously enlarged. Since the year 2006 at which China firstly becomes the biggest production country with 13.95 million t per year, the sharing ratio is consistently increasing. At 2010, it is even beyond half the global total production capacity.

Although China has its own large production capacity, 10% of the methanol consumed in China is imported. The import volume of methanol increased 14.2% annually, from 1.52 million t (year 2001) to 5.73 million t (year 2011) [11]. A dozen of countries benefit from this and export their methanol to China, such as Saudi Arabia, Malaysia, Qatar, Bahrain, Indonesia, New Zealand, India and Brunei [11].

Thereby, China's methanol industry is too big to ignore, reviewing and analyzing the flow chart (through production to consumption) of methanol in China can not only provide further information on the understanding of China's present and future methanol industry, but also provide significant information to the main methanol exporters. The flow chart reported in the present paper can give some valuable suggestions to the countries those will to and/or begin to establish their national methanol industry based on China's experiences.

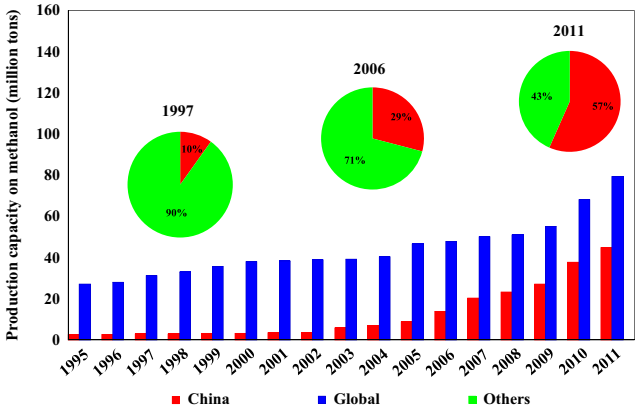

Fig. 1. Comparison of production capacity on methanol between China and the global.

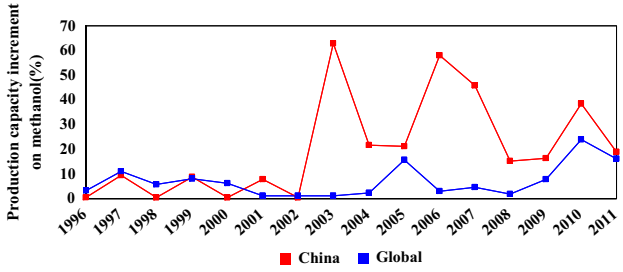

Fig. 2. Comparison of production capacity increment on methanol between China and the global.

2. Flow chart of methanol in consumption

In China, most of the methanol produced from fossil fuels and coke-oven gas is consumed primarily in the manufacturing of formaldehyde, alternative fuels, and acetic acid synthesis, which are utmost important materials for the development of modern construction industry, modern transportation industry, and modern chemical industry. Since the end of 1970s, the development of China's modernization was accelerated, this resulted in a skyrocketing demand of methanol. During the past three decades, the annual methanol consumption has increased by 71 times from 0.33 million t at 1983 to 23.84 million t at 2011 [12]. It can be unambiguously predicated that the annual methanol consumption in China will continuously increases in a long-term for the further developments of modernization.

2.1. Methanol consumption in formaldehyde synthesis

Formaldehyde synthesis is the major aspect to the methanol consumption for China, and occupies approximately 35% of the annual total methanol consumption, as shown in Fig. 3. Nowadays, China's industrial formaldehyde production from methanol is mainly based upon three approaches: (i) Dehydrogenation of Methanol (DoM) approach; (ii) Oxidation of Methanol (OoM) approach; and (iii) Oxidative Dehydrogenation of Methanol (ODoM) approach.

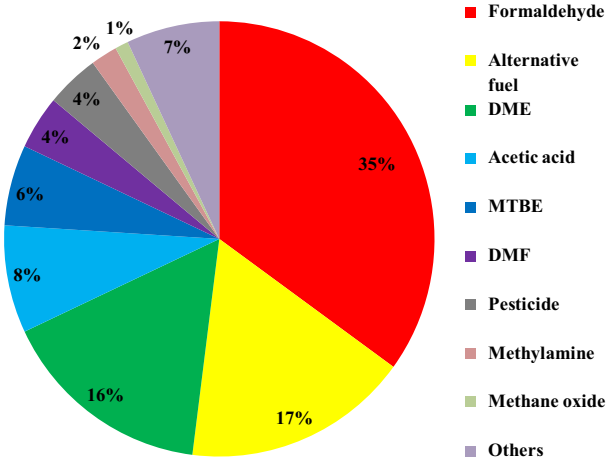

Fig. 3. Sharing ratio of each aspect on the consumption of methanol in China.