1 Introduction

Zinc is one of the most widely used nonferrous metals in the world. It has many merits such as anti-corrosion, low melting point, favorable thermal, ease of processing and electrical conductivity, which is one of the most important nonferrous raw materials in manufacturing production. So it is significant to study the supply and demand of zinc. There are many research results about analyzing and predicting the demand and supply of mineral resources, one of them was published by Wang et al. (2010), which proposed that changes in demand of mineral resources will follow the S curve rule fit with the development of social economy. Relying on the production, consumption and importation of zinc in America, and the development index of American economy from 1900 to 2013, in this paper we analyze the supply and demand of zinc in America and predict the demand and supply trends in America by utilizing regression analysis and fitting by using the least squares method on Matlab.

2 Data and Analysis

American primary zinc production refers to the metallurgical output of zinc mining, secondary zinc production refers to the waste and cinder from primary production, and the recovery quantity of finial zinc products after the life cycle in social storage. In order to analyze the supply and demand of zinc in America, the paper selects the production, consumption and importation of zinc in America and per capita GDP from 1900 to 2013 as sample data. The per capita GDP is calculated in the price of 2008.

The data indicates that the curve of the total production and primary production go to an S curve, and the total production reaches its peak in 1969 with an output of 1008000 tons. Because the severe contamination of zinc mining in its metallurgical process, the production has declined constantly since 1969 when the National Environmental Policy Act has issued- it declines to 248000 tons in 2011. At the same time, the production of secondary zinc, however, has a stable increase. This can be attributed to the consumption structure of zinc-galvanized zinc has taken up 60% of its total volume. Galvanized zinc is hard to recycle and its average life span can be up to 30 years (Yan et al., 2013), so the development of secondary zinc is relatively stable. But it is worth nothing that the American secondary production exceeds primary production from 2006, which provides a strong proof that America has payed more attention to the protection of environment.

The consumption curve of American zinc goes to an M curve instead of S curve. It is clear that the consumption is 90000 tons in 1990. Later in 1973 this number has increased to 1360000 tons to reach its first peak. Then the curve drops slightly but recovered to 1430000 tons in 1999 to its second peak, then drops again. A comparison between production and consumption can indicate that during this period, the production of American zinc is far below its consumption-less than a half (Fig. 1). And this demand gap, though filled partially by stock, relies greatly on importation. The external dependency is more than 70%.

The global zinc production is increasing dramatically

---

* Corresponding author. E-mail: chenshan8899@126.com

---

Fig. 1. Zinc production and consumption in U.S. from 1990 to 2013 (Data source: USGS).
During the latest ten years, the international market price of zinc has increased year by year. And in 2010, the average price of prompt LME zinc has increased 92%, comparing with the price in 2000. And the sharp rise in price has stimulated a tenfold investment on global zinc survey. Thus, global zinc production will continue its increase in the future and provide a sufficient supply. And the zinc demand in America can be filled, so America will choose to import large amount of zinc to cater its domestic demand.

3 Consumption Model of American Zinc

According to previous researches (Wang et al., 2010; Yue and Lu, 2007), there is a positive correlation between mineral resource consumption and economical development. In this paper, after fitting a consumption curve (Fig. 3) of American zinc by using the least squares method on Matlab, we get a relationship between per capita GDP and per capita consumption as follows:

\[ y = -0.000021828x^4 + 0.0026x^3 - 0.1102x^2 + 1.8892x - 5.7356 \]

Thus, it leads to a prediction that American zinc per capita consumption will decline about 1 kilogram in 2025, and domestic production from then on will meet its demand, which will reduce the dependence on importation.

4 Conclusions

(1) The curve in total production and primary production of American zinc goes to an S curve, and its total production reaches its peak in 1969 with 1008000 tons; and the consumption curve goes to an M curve, which declines since 1999. Secondary production increases slightly due to the consumption structure of zinc and the difficulty in recycling.

(2) The total production of zinc from 1900 to 2013 is significantly lower than its consumption-less than a half. American domestic demand relies greatly on importation during that period. The external dependency is more than 70%.

(3) Secondary production begins to exceed primary production since 2006, which indicates that American attaches greater importance to environmental protection. They transferred primary production to the developing countries, and improved the manufacturing technology of secondary zinc, which increased the secondary production.

(4) The international market price of zinc increases year by year, so a large amount of investment has been allocated to zinc survey. As a result, global zinc output will continue to increase in the future. And this sufficient supply of zinc will meet American domestic demand. However in 2025, the zinc per capita demand will be reduced to about 1 kilogram. So the domestic demand will be met by domestic production, which will lower American dependence on zinc importation.

Acknowledgments

We thank the United States Geological Survey for their data and information. We also thank all anonymous reviewers for their constructive comments and suggestions. This study was supported by the Investigation and Evaluation of the Secondary Resource Utilization project (12120113091700).

References


Yue Qiang and Lu Zhongwu, 2007. Analysis on the indexes of Copper Consumption in the process of industrialization for China and USA. Ecological Economy, 11: 28–32.