

WANG Junbo, LI Xin and LIU Yang, 2014. Sustainable Development and Utilization of Mineral Resources: Primary Copper and Secondary Copper. *Acta Geologica Sinica* (English Edition), 88(supp. 2): 1292-1293.

Sustainable Development and Utilization of Mineral Resources: Primary Copper and Secondary Copper

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1 Introduction

This paper we attempts to alleviate the current severe copper resource supply problems through exploring the sustainable development approaches in China. According to previous findings on predication of supply and demand for copper resource the from foreign scholars, in this paper, we sets up the relationship between per capita GDP and per capita consumption of copper in Chinese industrialization as the basis of copper resource consumption trends forecast. We also analyzes the energy consumption, cost, trade, prices and growing trends of primary and secondary copper and explores ways to optimize structure of the exploitation of copper resources.

2 Methods

According to the industrial stage of development theory, there is a very close relationship between the level of industrialized of countries and the per capita GDP. Therefore, this paper conducts regression analysis and fitting on the basic of the historical data of consumption per capita and per capita GDP, by using the least squares method on MATLAB, with the purpose of predicting Chinese copper consumption in the future.

3 Data and Analysis

In this paper, we use these parameters: per capita GDP, per capita consumption, unit energy consumption, unit production emissions, import and export volume between 1990 and 2013 in China. The purpose is to analyze copper resource consumption trends. The trends of China's demand for copper are predicted by regression, equation. In Fig. 1, the histogram of China refined copper supply and demand; In Fig. 2, The Consumption trends regression of China copper.

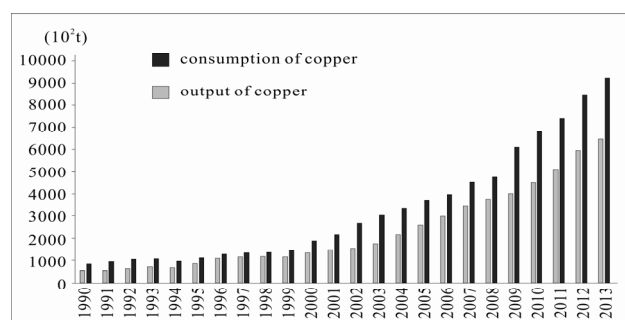


Fig. 1. China refined copper supply and demand.

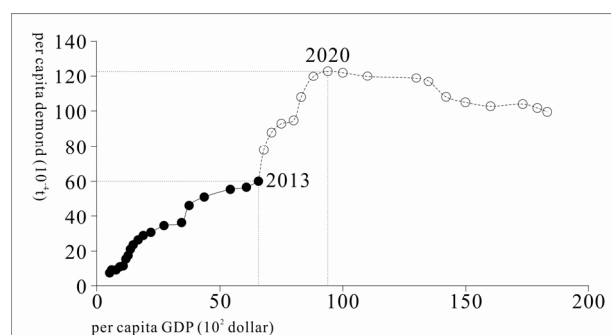


Fig. 2. Consumption trends (regression curve) regression (Data source: USGS, WBMS, WSA, NBS).

Equation:

$$y = -1E-07x^6 + 2E-05x^5 - 0.0018x^4 + 0.0501x^3 - 0.3944x^2 + 0.4655x + 10.433$$

The curve displays an inverted "U" shape of relationship between China's per capita GDP and per capita consumption. At present, China per capita GDP, which is approximately 6000 dollars, there is a large space for growing to peak of 12000 dollars per capita consumption. Then copper demand will rapidly increase in the future. Copper resources' supply pressure will increase more in the future. The gap between supply and demand of in latest five years remained about 2.4 million tons,

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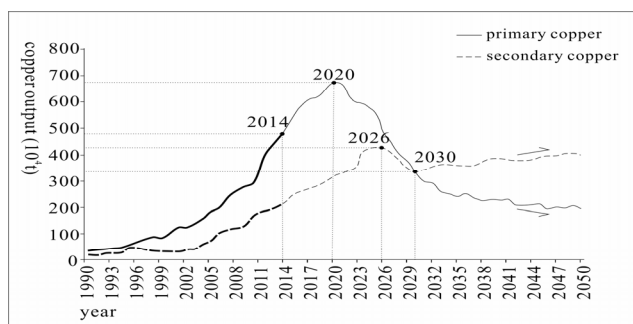


Fig. 3. China primary copper and secondary copper consumption trends (Data source: USGS, WBMS, WSA, NBS).

China copper demand will reach its highest value in 2020 up to 14 million tons. The demand is mainly depend on imports, the foreign refined copper has remained at around 75%, indicating the low self-supply ability of copper resources.

With the decline of copper stocks and quality copper resources the primary copper resource development and utilization of resources will face supply pressure. China's static tenure of copper resources is about 8 years, and the one of basic stock is about 13 years. Chinese coppers stocks are 27,344,000 t in 2012 (Cao, 2005), while the per capita amount of copper resources are only one fifth of the global level (112 kg). So the secondary copper industry will be vital to secure Chinese copper supply.

Compared with primary copper resources, secondary copper has a great advantage in energy consumption, environmental protection, and comprehensive utilization. The production of one ton of secondary copper reduces about 75% energy, including savings of 1.55 t standard coals and 395 m³ waters and reductions of 380 t solid emissions, 0.136 t SO₂ and 55000 t CO₂ emissions (Shao and Wang, 2012).

Currently, secondary copper production in China accounts for 46.6% of primary copper (Parul, 2012), close to the world average level, still far below the level of the industrialized countries of the world (U.S.65%, Germany 76%)(Agrawal and Sahu, 2010). Calculating the life cycle of copper resources from social consumption, the average lifetime of copper is about 30 years. According to this result, Chinese copper stock volume of social consumption will reach 90 million tons in 2020. The

available flow probably accounts for about 60% of the total stock (Fernando, 2007), indicating a coming rapid growth of secondary copper utilization in China. This paper argues that Chinese primary copper trend will be flat, and will take inverted "U" shape variation in the future. After exceeding primary copper in 2030, the secondary copper consumption will keep increase (Fig. 3).

4 Conclusion

China's copper resources consumption will reach a peak at 2020 when GDP per capita reach around 10000 dollars, and then begin to decline, and tend to be flat afterwards. China should rapidly develop secondary copper industry to solve high demand for copper resources and high-degree dependence on foreign countries in the future. China should also develop the alternative sources to reduce high-degree dependence on copper. Secondary copper production is expected to exceed primary copper production in 2030 and maintain the growth trend.

Acknowledgements

We would give our thanks to the United States Geological Survey and China Nonferrous Metals Industry for their data and related information. We would like to thank Prof. Tan Shumin for his guidance and kind encouragement.

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