

2.7 An Economic Benefit Analysis on the Cobalt-60 Irradiation Facility of Beijing Radiation Research Center

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Abstract the peculiarity, the investment and annual operating cost of the 3.7×10^{16} Bq (MCi) cobalt-60 irradiation facility at Beijing Radiation Application Research Centre are described. Its economic benefits each year are analyzed according to several year operating practice. Some related questions on carrying out radiation processing are raised and discussed.

INTRODUCTION

With the development of the radiation processing industry, the establishments of cobalt-60 source irradiation facility have been unceasingly increasing, Now, in China, there are more than 70 cobalt-60 source irradiation facilities, with a capacity of ten thousand Curie (3.7×10^{14} Bq) each, in which more than 40 sets have a capacity of one hundred thousand Curie (3.7×10^{15} Bq) each. The designed cobalt-60 source loading capacity for the irradiation facility of Beijing Radiation Application Research Centre is one million Curie (3.7×10^{16} Bq) and the practical loading by now is eight hundred thousand Curie (2.96×10^{16} Bq). Taking this as an example, I will make a preliminary analysis for its economic benefits according to the operating practice in several years, for your reference only.

This irradiation facility was based on a research work on the Radiation Sterilization of Medical Products in the periods of the Sixth Five-Year Plan, and it was listed as one of the State Key Importation Projects, "Radiation Sterilization Test Development Bases" in the Seventh Five-Year Plan, supported by the State Science and Technology Commission⁽¹⁾. At the same time, this project was also supported by the IAEA, being brought into the Regional Co-operation Project(CPR/8/002). This project was consisted of a productive factory of 50 million syringes and one hundred million needles per year, and a radiation sterilization base. Therefore, in choosing the type of the cobalt-60 source irradiation facility, The sterilization of medical products was considered as main objective. A facility providing with a closed irradiation cell, a rotary door for the products passing in and out, and a mode of pneumatically transferring products by rail, was chosen. The main advantages of this facility are safety, saving building area, high automation level, good dosage uniformity, high radiation availability, etc. Its shortage is that it can not irradiate products which need low dose⁽²⁾. After setting up of this facility, because the fifty million syringes and one hundred million needles per year did not be produced and irradiated according to the plan, for a variety of reasons, the source of goods to be irradiated was not enough seriously. Through an active promotion of the scientific and technical personnel at our Centre, the situation has been improved uninterruptedly. Till 1992, the facility was running in full load of goods, with an annual operation hours of more than 8,000, acquiring better economic benefits.

CAPITAL INVESTMENT AND OPERATING COST

Investment:	(Million yuan, RMB)
Equipment for irradiation facility	3.550
Cobalt-60 source(330 KCi)	1.350
Necessary home-made equipment	0.800
Civil works	2.200
Others (traffic vehicles, boxes for goods, etc)	0.60
Annual operating cost	(Million yuan, RMB, according to practical consumption in 1992)
Depreciation of equipment	0.435(10 years)
Consumption of cobalt-60 source	0.438
Depreciation of civil works	0.088
Wages	0.125
Charges for water, electricity and steam	0.105
Others	0.060

ANALYSIS FOR ECONOMIC BENEFITS

Because there are a variety of products(several dozens) to be irradiated at this facility, the prices for them are different and the quantities for each kind of product are also different, an average value is taken as a basis for calculation in this paper .

The income in 1992 was 2.55 million yuan(RMB), i.e. the average income per year was 7,300 yuan for per thousand Curie of cobalt-60 source. It was similar to that of the provinces Jiangsu, Hunan, etc. in our country ⁽³⁾ ⁽⁴⁾ . Below calculations are based on the level of this income per year.

When the cobalt-60 source loading at our Centre is 150 ,000 Curie, with a presupposition that the source of goods to be irradiated is guaranteed, it is in equilibrium between the income and the cost, when the loading is 350,000 Curie, the ratio for the income and the cost is 2:1. If the cobalt-60 source is one million Curie, the ratio becomes 3:1.

The investment recovery time is listed in the following table.

Source loading (KCi)	Annual revenue (Million yuan)	Investment recovery period (Year)
350	2.55	7.6
500	3.65	4.8
800	5.84	3.5
1,000	7.30	3.0

The loan interest did not be taken into account in calculating.

If a facility is built with an investment by a loan, the investment recovery periods will be prolonged properly in foregoing table.

DISCUSSION

1.If the products to be irradiated are enough, then, the cobalt-60 source loading is higher, the economic benefits are better, So, for a facility being built at present, it must be made to reach the designed cobalt-60 source loading capacity. For a cobalt-60 facility newly built, a fact that whether there are enough items to be irradiated or on must be carefully made sure.

2.Generally speak, better economic benefits will be acquired in irradiating the items which need a low dose. For example, the dose needed for garlics is about 3--4 order magnitude less than that for thermal shrinkable materials and butyl rubbers, but the charge collected for irradiation could not be increased proportionally with the increase of the dose. For this reason, for some small cobalt-60 irradiation sources, items which need low dose should be more developed.

3. The key point to raise economic benefits for radiation processing is to extend the market of irradiated products. In China, there are large amounts of products which can be or should be processed by irradiation technology. But now, only a few products are so treated. Why? I think, principally because the proper authority in the government did not establish strict standards and did not adopt supervision measures on the requirements for the production quality and the sterilization techniques. For example, most women-used sanitary towels sold in market did not reach the hygienic standards, according to an investigation of the All-China Women's Federation, while this problem can be easily solved by the use of the irradiation technology, But the department responsible for this work failed to make laws and adopt measures to force related factories to fulfil hygienic requirements. For another example, the ethylene oxide sterilization, which previously began to be used and has been keeping its processing price lower. The occurrence is accounted for the imperfect equipment at most sterilization plants, without the environment monitor and ethylene oxide residue testing means. These lead to a low processing cost. If the State strengthens the control and demands all ethylene oxide sterilization units to improve monitoring system and rigorously enforce the sterilization technology, this situation will be changed and the great part of medical products will be diverted to radiation sterilization.

4. Owing to the fact that the irradiation facility and its main spare parts are imported from abroad, and so is the cobalt-60 source, for them to pay US dollars is needed, while the charge for radiation processing are collected in RMB, which has an alterable exchange rate with US dollar, the analysis above-mentioned will be changed with the advance of time.

REFERENCE

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