Gamma Irradiators in China
Past, Present and Future

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Gamma Irradiators in China

- Less than 300 kCi: 80 Existing, 1 Under construction
- More than 300 kCi: 101 Existing, 9 Under construction

Safety and Quality that you can trust and afford
Gamma Irradiators in China (cont’d)

- All gamma irradiators use Cobalt-60.
- One experimental irradiator built in the 1980s’ using Caesium-137 was stopped.
Development history

The graph shows the number of new irradiators and the new capacity created over different decades. The x-axis represents the years 1960-1969, 1970-1979, 1980-1989, 1990-1999, 2000-2007, and those under construction. The y-axis represents the number of new irradiators and the new capacity created, ranging from 0 to 50. The data indicates a significant increase in the number of new irradiators and capacity created during the 1990-1999 and 2000-2007 periods.
The current picture

- Many units but only a few of them can be called commercial
- The cumulative design capacity (DC) is high but the actual source loading (AL) is low
- 80 irradiators with a capacity less than 300 kCi have a combined source load of less than 5.5 MCi
Until the 1970s

- The first gamma irradiator was built in Beijing in the late 1950s for agricultural research and other researches.

- Development was slow during 1960s and 1970s.

- Mainly located in research institutes or universities, irradiators were mainly used for experimental purpose.
Until the 1970s (cont’d)

• Static batch irradiator
• Basket source rack
• Design capacity from only several kCi to 300 kCi
• Manual or Electric motor used for the source hoist system
• Single maze
• Product manually taken in and out of irradiator

Layout of a typical batch irradiator
1980s

- Fast development
- Main uses are for agricultural and industrial purposes
- Design capacity increases to 500 kCi
- Automation of product transportation
1980s (cont’d)

- Hanging chain system for source pass and maze conveyor
- Carriers used
- Products switch in carriers is manual
- Introduction of PLCs
- Source overlapping mode with low efficiency

Layout of a typical irradiator
1980s (cont’d)

• In 1987 and 1989, 2 industrial gamma irradiators built in China by foreign suppliers.
  • Design Capacity: 4MCi (Shenzhen) and 1 MCi (Beijing)
  • Fully automatic
  • Demonstration and Promotion
1990s

- Rapid development: on average 3 to 4 irradiators built each year
- Mainly used for commercial purposes
- Still used the technology of the 1980s
- Design capacity: 300-500 kCi
- In 1993, another irradiator with a design capacity of 3 MCi (Qingdao) was installed by a foreign supplier
1990s (cont’d)

• Following the development of irradiation, regulations and standards were revised and established.

• International reference used:

  IAEA safety series 107

• Chinese regulations:

  GB17568-1998
  GB10252-1988,1996
  GB17279-1998

• These standards paved the way for the next phase of development.
2000s

• Very rapid development
• Improvements in performance, automation and safety
• Design capacity grows between 1 MCi and 5 MCi.
• Mainly for commercial purposes
• SQHL designs and supplies a 6 MCi irradiator for Thailand
2000s (cont’d)

- A total of 44 irradiators were built from 2000 to 2007
- Total design capacity: 61 MCi
- Average design capacity per irradiator: 1.4MCi
- Actual source inventory: 20 MCi
- Mainly for the radiation processing of medical device sterilization
- Many old irradiators are upgraded or refurbished to improve efficiency or comply with regulations
- 10 irradiators still under construction
Examples of new irradiator
Examples of new irradiator (cont’d)
Outlook on the evolution

• All but 3 irradiators are of indigenous design and components.

• Accumulated experience in hours of operation and number of units now greater in China than in any other country.

• Technological level now matches or exceeds foreign irradiators.

• China has now started exporting irradiators.
Outlook on the applications

Early interest was in agricultural and scientific research, hence the location of irradiators within institutes and universities.

Interest shifted to other fields and commercial use started.

Irradiators now also owned by agricultural organizations and commercial companies.

Main current uses:
• medical sterilization,
• food preservation and quality,
• traditional herbs microbiological control.

Percentage in number of units:
- Company: 71%
- University and other institute: 17%
- Agricultural institute: 12%
Safety and Quality that you can trust and afford

Geographical distribution

- Bohai Rim (21%)
- Yangtze Delta (45%)
- Specially Shanghai and Jiangsu (23%)
The technical progress - safety

- The governing body of Irradiators is Ministry of Environmental Protection (MEP)
- Many laws and regulations effected
- Designers and suppliers adopted advance technology and international standards
- The preventive maintenance measures used during the operation, especially for the safety interlock system
- Reliable

• The parts use very high quality products

• The utilization of the new irradiators can reach 95% to 99% of the total available time in a sustained manner.

• PLC and barcode systems are used to ensure the reliability and the traceability of the irradiation process.
Many new techniques now contribute to better Gamma Irradiators:

- PLCs and Computers
- Networks
- Barcode
- Video
-Management

• The traditional management model used for old irradiators. Paper form used only.

• The new irradiators can be managed according to the modern management model. Electric form started to be used.

• The network and internet can be used for the management.
Quality compliance

• Capability to comply with international standards for medical devices and sterilization:
  ISO 13485; ISO 11137; EN 552 ……

• Capability to be certified by reputable notified bodies, certifications organizations and national or international organizations such as FDA, USDA
Business development trends

• Many products made in China are still irradiated outside China;
• These volumes will decrease given the increase in capacity and quality of the irradiators in China
• The number of new gamma irradiators in China will increase but many older irradiators are likely to close.
Technical development trend

• Economy of scale
  Design capacity will keep increasing to 5-10 MCi

• Specialization
  Irradiators will specialize in medical devices or food irradiation.

• Automation
  Because of the rising labor cost, automation will keep increasing.
Geographical development trend

- Irradiators will remain mainly located in the Yangtze Delta and Bohai Rim.
- However, following the government policy to develop Western and Northeastern China, new irradiators will also soon be located in these areas.
Development trend

- The total design capacity far exceeds the current needs and the actual source loading.
- Adjustment to growing market needs can be fast.
- The number of new irradiators is likely to increase more slowly than before.
- Source loading of existing large irradiators is likely to increase quickly.
- Most small size and old irradiators will be closed.
Cobalt-60 availability

Availability and price of cobalt-60 will be a key factor in the development of gamma irradiation in China also.
Cobalt-60 availability

- China plans to produce Co-60 in the third Qingshan Nuclear Power Plant;
- The first batch of Co-60 will be available in 2010;
- The yearly production will be about 7 MCi;
- This production will not be sufficient to cover the annual needs in China estimated to be between 8 and 10 MCi yearly from 2010.
Conclusion

- Irradiation technology in China has been maturing over half a century
- It is now applied on a large scale and places China at the forefront on the international scene
- Irradiators made in China have reached a level of technology, quality and safety that is one of the highest in the world
- The Chinese irradiation industry is now strong and will keep growing, more in terms of installed capacity than in terms of new facilities
The end

THANK YOU FOR YOUR ATTENTION!

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