12-9 Challenges to Domestic Production of ^{99}Mo Using JMTR

— Development of a New Mo Adsorbent for ^{99}Mo-^{99m}Tc Generator —

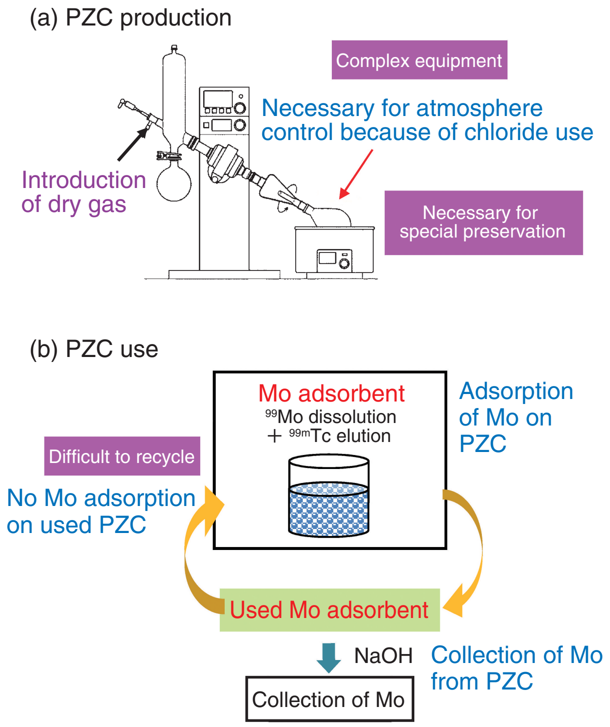

Fig.12-21 Properties of the conventional Mo adsorbent (PZC)
(a) In PZC production, it is necessary to use complex PZC production equipment and preserve PZC using a special method.
(b) Recycling of used PZC is difficult.

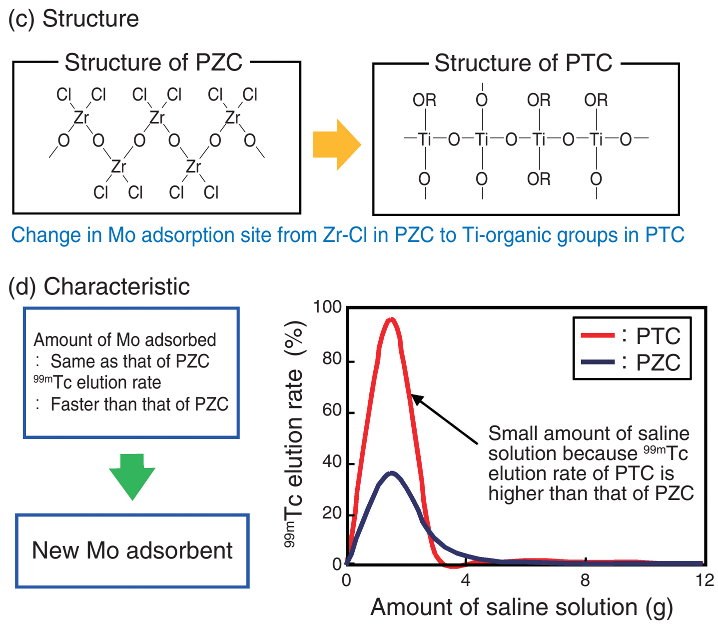

Fig.12-22 The newly developed Mo adsorbent
(c) A new Mo adsorbent with Ti-organic groups as Mo adsorption sites was successfully synthesized without using chloride.
(d) The performance test shows that the new Mo adsorbentadsorbs almost the same amount of Mo as does PZC but has a higher ^{99m}Tc elution rate.

^{99m}Tc is used as a radiopharmaceutical for diagnosis. ^{99m}Tc is used in more than 50% of the nuclear medicine diagnosis cases in Japan. ^{99m}Tc is obtained from the β-decay of ^{99}Mo. The demand for ^{99}Mo in Japan is the second highest in the world; however, the supply of ^{99}Mo depends entirely on the import from foreign countries. A steady supply of ^{99}Mo from domestic production is required because of the unplanned shutdown of aged research reactors that produced ^{99}Mo, in foreign countries, and the difficulty in the airlift to Japan owing to volcanic eruption. ^{99}Mo is obtained by separating the fission products of ^{235}U, from the neutron capture reaction ^{98}Mo(n, γ)^{99}Mo, etc. The ^{98}Mo(n, γ)^{99}Mo reaction has been selected for ^{99}Mo production in the Japan Materials Testing Reactor (JMTR). Poly-zirconium compound (PZC) has been studied for use as a Mo adsorbent in a ^{99}Mo-^{99m}Tc generator. However, PZC requires complex equipment for synthesis and special preservation methods and is difficult to recycle (Fig.12-21). Hence, the technical development of a new Mo adsorbent was started to overcome these drawbacks. In this process, first the structure of the Mo adsorbent was analyzed. Next, the Mo adsorption sites were changed from chlorine groups to organic groups (Fig.12-22(c)). Titanium alkoxide was used as the raw material instead of zirconium tetrachloride ($ZrCl_4$). Consequently, the equipment was simplified because chlorine removal was no longer required. From these studies, a production method for a new Mo adsorbent, polytitanium compound (PTC), was developed.

A performance test was carried out on PTC at Japan Research Reactor No.3 Modified (JRR-3M). It was found that the amount of Mo adsorbed by PTC is the same as that adsorbed by PZC and that the ^{99m}Tc elution rate of PTC is higher than that of PZC (Fig.12-22(d)). Furthermore, it was found that Mo can be collected from the used PTC and that the Mo-desorbed PTC can be reused. Thus, this development contributes to the reduction of radioactive waste.

Reference
Kimura, A. et al., Development of New Molybdenum Adsorbent, JAEA-Technology 2011-012, 2011, 17p. (in Japanese).