PRODUCTION OF IODINE-125 IN NUCLEAR REACTORS: ADVANTAGES AND DISADVANTAGES OF PRODUCTION IN BATCH OR CONTINUOUS PRODUCTION IN CRYOGENIC SYSTEM

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Cancer is one of the worst illnesses in the world and one of the major causes of death in Brazil [1,2]. For this reason, the Nuclear Energy National Commission (CNEN) started a project to produce some medical radioisotopes to treat cancer. One of the main products is the iodine-125 seeds [3]. This iodine seed can be used to treat several kinds of cancer: prostate, lung, eye, brain. As Brazil will construct a new reactor to produce radioisotopes, it is necessary define how the iodine-125 production will carry out [4,5]. The main reaction of this production is the irradiation of the enriched xenon-124 in gaseous form. Xe-124 changed to Iodine-125 by neutron capture following in two decays: Xe-124 (n, γ) → Xe-125m (57s) → I-125 or Xe-124 (n, γ) → Xe-125 (19.9 h) → I-125. However the production in reactors is the most common technique used, there is one disadvantage to use it: the production of iodine-126 after several hours of irradiation. Iodine-126 has a half life of 13.1 days and it has some usefulness emitters for medical uses. Iodine-126 is considered a contamination [6]. For all these reasons, the IPEN/CNEN-SP research group decided for two techniques of production: in batch or continuous system. The production in batch consists in a sealed capsule that is placed in the reactor core for around 64 hours. In this type of production, some iodine-126 is produced and a certain quantity of Xe-124 is not activated. Normally, it needs to wait around 5 to 7 iodine-126 half-lives to guarantee the decrease of the activity of the contamination. This time will make Iodine-125 with only 50% till 34% of the initial production. The second technique is the continuous production using a cryogenic system. This technique consists in two capsules: one inside the reactor core and the second one out of the neutron flux. These two capsules will be linked with two cryogenic pumps to guarantee that all iodine-125 produced in the core will be take off the reactor core. The great disadvantage of this technique is the using of two positions in the core of the reactor. Brazil will have only one radioisotope reactor producing. And like there is a huge quantity of materials to be produced, it is not a guarantee the position in the reactor for this production. Besides of that the seeds production in Brazil is only 3000 per month, which demands around 3.5 Ci per month. The batch production produces a low quantity per reactor cycle of iodine-125, but this low quantity can be more than that [2,3].

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