Methodology to prepare organic radiotracers labeled with ^{123}I

V. P. do Araujo[1] , L. E. B. Brandão[1], I. Taan[2], A. W da Nóbrega[2]
E-mail: valeska@ien.gov.br, brandao@ien.gov.br

[1] *SETMQ/IEN/CNEN*
[2] *ATOMUM Serviços Tecnológicos Ltda.*

Keywords: radiotracer, labeling process, oil

Non-destructive tests are the most appropriate methodologies to examine an apparatus in industrial plants, and one of the best techniques is that employ gamma-emitting radiotracers. Four factors are essential in the selection of a radiotracer for an inspection, and they are:

- the radiotracer must remain intact during the test.
- The half-life must be long enough to guarantee the whole experiment and relatively short to minimize occupational exposure.
- The gamma-ray energy must pass all the physical barriers.
- The labeling methodology must be fast and viable.

This work aimed to develop a procedure for the synthesis of organic halides marked with radioiodine. [1,2]. The labeled process investigated uses iodine monochloride (ICl) as a carrier to link the radioactive iodine into double bonds of the oil molecules. To check the labeling methodology, 100.0 µL of the initial $Na^{123}I$ was collected (labeling stage LS-0), and its activity was measured and used as a reference value. In a separation funnel, 5.0 ml of KI (0.1 N) was mixed with water (5.0 ml) and 10.0 ml of concentrated HCl acid (4N). After this, the $Na^{123}I$ radioactive solution (LS-0 labeling step) is added to the system, and KIO_3 (0.1 N) is gradually added.

$$KIO_3 + HCl + 2KI + NaI \rightarrow 3ICl + 3KCl + H_2O \quad (1)$$

The stoichiometric balance of equation (1) is controlled using carbon tetrachloride as a color indicator. When the balance of the equation (1) is reached, the ICl is extracted by adding 2.0 ml of ethyl ether and vigorously shaking the system for five minutes. After this, maintain the system in rest until the separation of the two phases occurs. This procedure is repeated twice (LS-1A and LS-1B labeling stage) to ensure the radioiodine is extracted. The organic phase is transferred to a new container with 5.0 ml of regular oil and shaken for 2.0 minutes. After that, the oil is heated at 40ºC for 30 minutes to remove the ethyl ether (LS-2 labeling stage). The labeled oil is washed with water: 5.0 ml of labeled oil by slowly shaking in 50.0 ml of water for 5.0 minutes, and the two-phase mixture was separated by centrifugation. This operation was repeated twice, and the gamma activity was measured (LS-3A and LS-3B labeling step). The gamma activity was measured using a dosage calibrator and the results for the different steps are in Table 1. (W for aqueous and O for oil samples).

Table 1: The yield of 123I oil labeling process

WLS 1A	WLS 1B	OLS 2	WLS 3A	WLS 3B	OLS 3A	OLS 3B
7.81	5.12	88.74	0.44	0.38	85.46	84.92

The residual activity at WLS-1B shows that 95.0% of the initial gamma activity was transferred to the organic phase. After two extraction steps, only 5.0% of radioiodine was measured in the aqueous phase. The oil labeling process is better assessed by measuring the "iodine value" that determines the number of existing double bonds in the oil molecules. [3,4]. Before the labeling process, the "iodine number" measured was equal (66,37 ± 0,43); after the labeling step 2, the "iodine number" of OLS-2 was measured and was (6,75 ± 0,62). This reduction proves that the iodine is bonded to the oil.

References

[1] YOSHIDA, J.; SUGA, S.; KATAOKA, K.; MIDORIKAWA, Y.; HAGIWARA, Y. Method of producing iodizing agent and method of producing aromatic iodine compound, Patent Application Publication US 2010/0105969 A1 (2010).
[2] GANT, P. L., YANG, K., YUNG. K. Method for making a radioactive partitioning tracer, Patent Application Publication 4.857.234 (1989),
[3] LEA, R. V. P. Avaliação metrológica de métodos para determinação de índice de iodo em biodiesel B100, EQ/UFRJ, (2008).
[4] ARICETTI, J. A. Métodos titulométricos alternativos para a avalição da qualidade de biodiesel Métodos titulométricos alternativos para a avalição da qualidade de biodiesel, IQ/UNICAMP (2010).