

CRITERIA FOR THE MANAGEMENT OF RADIOACTIVE TEA A Unique Experience of Radioactive Pollution

AHMED Y. ÖZEMRE*

SUMMARY : After the Chernobyl accident, the tea plantations at the north-east region of Turkey, especially in Rize and the neighborhood have been affected by radioactive fall-out. As a measure of radiological protection, the Turkish Atomic Energy Authority intervened before the stage of packing of the tea, and imposed a maximal limit of 12.500 Bq/kg for the tea on the market. 58.078 tons of contaminated tea of 25.000 Bq/kg and more has been isolated for disposal. In order to determine the optimal mode of disposal the Turkish Atomic Energy Authority developed four criteria for the management of radioactive tea which permitted to establish that the only mode of disposal satisfying all these criteria was the burial of the contaminated material.

Key word: Radioactive tea.

Intervention level for tea after the Chernobyl accident

The radioactive fall-out which occurred two weeks after the Chernobyl accident over the north-east region of Turkey had an impact on the tea plantations along with tobacco and hazelnut plantations.

The early evaluations indicated clearly that the level of radioactivity in tea was sufficiently low, so there was no necessity for an immediate intervention from the point of view of radiological protection, and the Turkish Atomic Energy Authority decided to intervene only before the stage of packing. It was decided that the level of radioactivity in the packed tea should not exceed 12.500 Bq/kg.

In the European Community, the intervention level of radioactivity for liquid foods was accepted as 370 Bq/liter for pregnant women and children less than one year of age. The infused tea prepared with dry tea of 12.500 Bq/kg radioactivity does in fact not contain a radioactivity more than 370 Bq/liter even by assuming pessimistically that all the radioactivity of the dry tea goes into the infused tea. In reality, and according to the mode of infusion, only 60% of the radioisotopes Cs-134 and Cs-137 contained in dry tea goes into the infused tea.

This measure taken by the Turkish Atomic Energy Authority was sufficiently drastic only for pregnant women and to children of less than one year of age, but for all population of Turkey.

* Formerly, Director General of the Turkish Atomic Energy Authority, Türkiye.

The level of radioactivity in 145.000 tons of tea produced in 1986 by Çay-Kur, the national tea producer, was ranging from 0 to 89.000 Bq/kg with a weighted average of 30.000 Bq/kg. Çay-Kur had also a stock of 55.000 tons of uncontaminated tea from the 1985 production. The main problem the Turkish Atomic Energy Authority faced was to blend this uncontaminated tea to that partially radioactive one in order to obtain, approximately, an amount of 120.000 tons of tea just sufficient for yearly national consumption and having a level of radioactivity less than 12.500 Bq/kg.

It was necessary to be well organized for the balanced blending of the contaminated and uncontaminated tea groups; and that has been not easy for both Çay-Kur and the Turkish Atomic Energy Authority. In the packing plants of Çay-Kur in Rize, Ankara and Istanbul, the level of radioactivity of each set of blended tea was measured by the qualified personnel and systems, both provided by the Turkish Atomic Energy Authority. During the blending operation the level of the radioactivity was tried to be maintained below 12.500 Bq/kg.

The operation was carried out successfully; and the level of radioactivity has been firmly maintained at 12.500 Bq/kg within the first month, whereas during the next two months this level is gradually and successfully reduced first to 8.000 Bq/kg and thereafter to 3.000 Bq/kg.

The Turkish mode of tea preparation includes two phases. The first one, properly, is the infusion where tea is infused in hot water during 15 or 20 minutes. In the Turkish mode of tea infusion, 20 grams of dry tea is needed to obtain one liter of infused tea. In the second phase, this infused tea is diluted in teacups by adding a volume of hot water 3 or 4 times greater than the volume of the infused tea, according to the personal taste.

All these procedures drop the level of radioactivity in a full Turkish teacup (having approximately 100 to 125 cm³ to 5-7 Bq which is of the same order of the natural radioactivity found in some mineral water sources of Turkey.

Criteria for the management of radioactive tea considered as a radioactive waste

When the operation of blending was terminated, 58.078 tons of radioactive tea remained, with a radioactivity level range from 25.000 to 89.000 Bq/kg. All the data were indicating that the tea harvest in the following year would have a negligible radioactivity level. So, according to the ethical principle of radiological protection, the so called ALARA Principle which states that the level of radioactivity in any process which may contaminate the environment or in any food should be As Low As Reasonable Achievable, these 58.078 tons of tea were decided to be first isolated and then eliminated as a radioactive waste.

This rather huge quantity of tea considered as a radioactive waste was surely going to be a serious problem to manage. Such a specific situation was to be considered for the first time in the history of mankind. So, it implied careful considerations and discussions, and led to the adoption of the following four criteria for the management of radioactive tea. These criteria would help to make a sound selection among a dozen proposed modes of disposal, some of them being nevertheless too exotic:

Criterion of health: The mode of disposal of radioactive tea should not contaminate the environment.

Criterion of finance: The mode of disposal as well as its consequences should be the most economic.

Criterion of public opinion: The disposal of radioactive tea should be realized as rapidly as possible to prevent the radioactive tea figure continuously in the national agenda and the image of "radioactive Turkish tea" become gradually an indelible pessimistic symbol.

Criterion of political preservation: The mode of disposal of radioactive tea should be also the policy of the Government as well as the related public dignitaries.

And for this reason, the mode of disposal to be adopted would be so that it could not be possible to criticize and accuse the Government and the related dignitaries for their decision.

These criteria combined with detailed feasibility studies led to the conclusion that the best solution was the simple burial of the radioactive tea. This solution was satisfying all of the four criteria, whereas the burning of the radioactive tea which was one of the other proposed solutions would not satisfy any to these criteria.

The selection of adequate sites for disposal had also vital importance; and in that sense, these sites : 1) should not be very far from the stores containing the radioactive tea, and 2) should not be in contact or in the close vicinity of underground water sheets. The quality of sites for disposal would surely affect the timing of the operation.

Under the optimal circumstances and according to a detailed feasibility study, all the operations for burial of 58.078 tons of radioactive tea would take 4 to 7 months, according to different strategies to be adopted in view of the quality of the sites for disposal.

The unsuccessful polemic about the elimination of radioactive tea by burning

There were also some scientists who defended the elimination of that radioactive tea by burning. This thesis gave rise to a polemic, but it had no chance to be adopted, because the Turkish Atomic Energy Authority had already realized that the burning of the radioactive tea would not be the adequate solution for the elimination. In fact, a series of detailed experiments performed in Çekmece Nuclear Research Center enhanced by a thorough theoretical analysis revealed that the elimination of the radioactive tea by burning would certainly not be a solution at all; on the contrary, it would give rise to a multitude of many more difficult new problems. The results of these experiments of radioactive tea burning, using different kinds of fuel, clearly established that:

1. Tea is not a combustible material,
2. The heat energy released by the burning tea is rather low,
3. The optimal burning of the tea is obtained by fuel burning with oil, and the worst burning is realized when the tea is burnt mixed with coal or on the coal,
4. Even in the case of the optimal burning and using special filter to prevent burnt tea ashes to spread out from the chimneys of the furnaces, there would be a remaining amount of 35 to 40 thousand tons of burnt tea ashes with a much more specific activity than that contained in the radioactive tea itself,

5. In the case of the worst burning and without using any filter, there would be some 20 to 25 thousand tons of burnt tea ashes to remain in the furnaces whereas, 10 to 20 thousand tons of highly radioactive ashes would spread out by the chimneys and contaminate the environment.

This 58.078 tons of radioactive tea could be burnt economically only in the furnaces of the tea plants of the region. An original plant with a high chimney endowed with special cesium filter and specifically designed to burn radioactive tea even at a rate of 200 tons/day would take two or three years to be operative, and would also cost approximately 15 to 20 times the cost of the operation of burial.

Even in the optimal conditions, the remaining huge quantity of radioactive ashes would constitute another problem of disposal of radioactive waste. This time, the problem of disposal of these radioactive ashes would be much more difficult to tackle, due to their high radioactivity and also to their extreme ease of dispersion.

If the radioactive tea was burnt in the furnaces of the tea plants : 1) The operation of burning itself would last at least 10 years, 2) This operation would give rise to a voluntary contamination of the environment absolutely contradictory to the ethical ALARA Principle, 3) The total amount of fuel needed for this operation would be approximately 250.000 tons of coal, when burnt, it

would induce acid rains in the region of Rize where, in the average, 320 days of the year are rainy.

It is easy to conceive that all these facts do not satisfy any of the four criteria the Turkish Atomic Energy Authority had adopted, so this polemic has been easily discharged and the 58.078 tons of tea considered as a radioactive waste had to be buried.

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Correspondence:
Ahmet Yüksel ÖZEMRE
Formerly, Director General of the
Turkish Atomic Energy Authority,
TÜRKIYE.