



Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

Sixty-fifth session

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Item 3 of the provisional agenda

Listing, classification and packing

Listing of Artemisinin and derivatives in 2.5.3.2.4

Transmitted by the expert from China, and the European Chemical Industry Council (Cefic)*

I. Introduction

1. At the sixty-fourth session of the Sub-Committee of Experts, the expert from China, and the European Chemical Industry Council (Cefic) presented an informal document that proposed to amend the entry "[3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR**)]-DECAHYDRO-10-METHOXY-3,6,9-TRIMETHYL-3,12-EPOXY-12H-PYRANO[4,3-j]-1,2-BENZODIOXEPIN)" to "ARTEMISININ or ARTEMISININ DERIVATIVES" in the list in paragraph 2.5.3.2.4 of the *Model Regulations* based on the inaccuracy of the original entry name (see INF.40, sixty-fourth session).¹ During the discussion of the document within the Explosives Working Group (EWG), this proposal received general support. However, there was a concern about including all derivatives in the list and it was suggested to list by name only the relevant ones instead of having them referred to in a note.

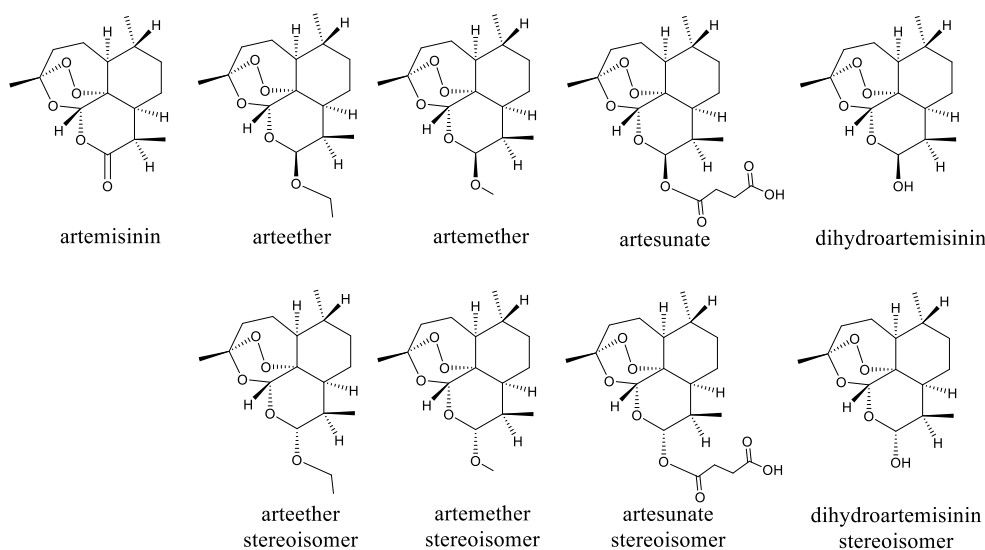
2. Artemisinin is a natural product with a peroxide bridge structure extracted from the plant of *artemisia annua*, which is one of the most effective drugs for the treatment of malaria. A series of derivatives produced by deep processing of artemisinin are also often used in the treatment of malaria. Common artemisinin derivatives include arteether, artemether, artesunate, dihydroartemisinin, etc. with a subset of stereoisomers thereof (see figure). The specific chemical structure can be determined through the generic names.

* A/78/6 (Sect. 20), table 20.5.

¹ <https://unece.org/sites/default/files/2024-06/UN-SCETDG-64-INF40e.pdf>



Artemisinin and common derivatives (including stereoisomers)



3. Artemisinin and artemisinin derivatives (including stereoisomers) have similar molecular structures, all containing a single peroxide bridge, and having the properties of organic peroxides. Some institutions such as the “Nanjing University of Science & Technology” (NJUST), the “Netherlands Organisation for Applied Scientific Research” (TNO) and the “Federal Institute for Materials Research and Testing” (BAM) have carried out classification tests on artemether, artemisinin and dihydroartemisinin, and some competent authorities have also provided classification results for artemether. Artemether as currently given in 2.5.3.2.4 was classified as organic peroxide type D (UN 3106). Artemisinin was classified as either organic peroxide type D (UN 3106) or organic peroxide type E (UN 3108), and according to the conservative classification, organic peroxide type D (UN 3106) is recommended. Dihydroartemisinin was classified as organic peroxide type D (see table).

Classification result of artemether, artemisinin and dihydroartemisinin

Generic name	Chemical name	Organic peroxide type	Institution/Competent authority
artemether	(3R,5aS,6R,8aS,9R,10S,12R,12aR)-decahydro-10-methoxy-3,6,9-trimethyl-3,12-epoxy-12H-pyrano [4.3-j]-1,2-benzodioxepin	type D	TNO
artemether	([3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR**)]-Decahydro-10-methoxy-3,6,9-trimethyl-3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin) (may be inaccurate)	type D	Swiss Federal Inspectorate of Dangerous Goods, Cert. No. 4'205'570
artemether	Not provided in the original document	type D	U.S. Department of Transportation, CA2006080015 (3 rd Rev.)
artemisinin	molecular formula: C ₁₅ H ₂₂ O ₅	type D	NJUST, 2011
artemisinin	(3R,5aS,6R,8aS,9R,12S,12aR)-Octahydro-3,6,9-trimethyl-3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin-10(3H)-one	type D	BAM
artemisinin	3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin-10(3H)-one, octahydro-3,6,9-trimethyl-, (3 α ,5 α β ,6 β ,8 α β ,9 α ,12 β ,12aR*)-(+)-	type E	TNO, 2012
dihydro-artemisinin	3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin-10-ol, decahydro-3,6,9-trimethyl-, (3R-(3 α ,5 α β ,6 β ,8 α β ,9 α ,10 α ,12 β ,12aR*))-	type D	TNO

4. For stereoisomers of artemether or dihydroartemisinin, the molecular structure is almost identical to that of artemether or dihydroartemisinin, and it is inferred that the degree of danger of organic peroxide is the same as that of artemether or dihydroartemisinin. For arteether, artesunate and their stereoisomers, they have similar molecular structures to artemether and dihydroartemisinin, while having a larger molecular weight and lower available oxygen content, and it is inferred that their degrees of danger of organic peroxides

do not exceed artemether and dihydroartemisinin. In order to facilitate the transport of these substances, it is recommended to refer to artemether and dihydroartemisinin, classifying them as organic peroxide type D (UN 3106) in accordance with the conservative estimates, with the packaging method OP7 assigned.

II. Proposal

5. Amend the list in 2.5.3.2.4 as follows:

Delete the following entry:

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%)	Inert solid (%)	Water	Packing Method	Control temperature (°C)	Emergency temperature (°C)	Number (Generic entry)	Subsidiary hazards and remarks
([3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR**)]-DECAHYDRO-10-METHOXY-3,6,9-TRIMETHYL-3,12-EPOXY-12H-PYRANO[4,3-j]-1,2-BENZODIOXEPIN)	≤ 100					OP7			3106	

Add the following entries:

ORGANIC PEROXIDE	Concentration (%)	Diluent type A (%)	Diluent type B (%)	Inert solid (%)	Water	Packing Method	Control temperature (°C)	Emergency temperature (°C)	Number (Generic entry)	Subsidiary hazards and remarks
ARTEETHER (Including stereoisomers)	≤ 100					OP7			3106	
ARTEMETHER (Including stereoisomers)	≤ 100					OP7			3106	
ARTEMISININ	≤ 100					OP7			3106	
ARTESUNATE (Including stereoisomers)	≤ 100					OP7			3106	
DIHYDROARTEMISININ (Including stereoisomers)	≤ 100					OP7			3106	