Subject	Sodium Hypochlorite and concern impurities emission test
Date	16 April 2024
From	[redacted] – Manager PSRA - Avantium

Introduction

In the document Rev A: 05-BB001500/G.93a/9018 ARNP, Flagship Plant BV requests the use of Sodium Hypochlorite for the cooling water system and its disposal through the wastewater treatment.
In this document the evaluation if sodium hypochlorite meets the required norms is reported.
Avantium was asked to evaluate the impact of haloforms impurities such as bromoform and bromate.

Emission test

Sodium Hypochlorite

Sodium hypochlorite is rapidly converted in cooling water. With this, it can to some extent be considered "readily biodegradable". The effluent concentration of hypochlorite is expected to be 3ug/L, leading to a concentration of 0.016ug/L at 1km distance, as shown in the original application, Table1.

Substance	Effluent Concentration [mg/L]	Concentration MKN-distance [ug/L]	MTR-norm [ug/L]
Sodium Hypochlorite	0.003	0.016	0.3

Table 1. Based on Table 3.7 of the application request to use Hypochlorite in the cooling water system

According to the online emission test, https://www.immissietoets.nl/berekening/immissietoets, the sodium hypochlorite emission meets the norms (Figure 2 and Annex 1 for full emission test)

Figure 2. Emission test result for Sodium Hypochlorite

Impurities in Sodium Hypochlorite

Avantium has been informed that sodium hypochlorite can lead to the addition of harmful products such as bromate. Bromate is a substance of great concern and Sodium Hypochlorite can contain 34 to 37 mg bromate per kg of Sodium Hypochlorite, according to diverse literature.

Considering bromate can be present up to 37mg per Kg of added sodium hypochlorite, Avantium looked into the emission of this substance in a worst case scenario, considering the full consumption of Sodium hypochlorite (6132L/year) and the maximum known concentration of bromate in hypochlorite (Table 2).

Further Avantium considered side reactions to bromoform, considering that 1 wt% of the Sodium Hypochlorite could lead to the formation of this substance.

The emission test cannot be done directly online as the website doesn't recognize these two substances. So the norms of bromate and bromoform have been searched for in the website of RIVM (https://rvszoeksysteem.rivm.nl/) Table 2 shows that the emission of bromate and bromoform, in worst case scenarios, are lower that the significant emission.

Table 2: Emission test on potential impurities of concern

Substance name	CAS number	MTR* (sweet water)	JG MKN* (sweet water)	Significant emission in salt water **	Impurity concentration in relation to Sodium Hypochlorite	Impurity concentration at 1km distance
bromate	15541-45-4		1ug/L	**0.01 ug/L**	37mg/kg	0.00021ug/L
bromoform	75-25-2	11.3ug/L		**0.113 ug/L**	1wt%***	0.057ug/L

* RIVM website

** Factor 10 for correction of salty water and factor 10 correction for the significant emission

*** Assuming that 1wt% of the added sodium hypochlorite is bromoform

Conclusion

The concentration at 1 km distance from the emission point of sodium hypochlorite and potential concern substances formed due to the impurities in sodium hypochlorite are below the significant emission allowance.

ANNEX 1

Emission test Sodium Hypochlorite