MOST URGENT

BURAU OF INDIAN STANDARDS
Central Marks Dept-II(Legal)

Ref: CMDII(L)/16:14543 Dated: 05 February 2015

Subject: Action by RO/BOS on the report published in respect of presence of bromate in packaged drinking water, by BARC, Mumbai

Reports were published in various news items on January 11, 2015 based on a paper published by BARC, Mumbai regarding presence of bromate beyond the WHO limits in Packaged Drinking Water for the samples collected by them (Annex-A).

The matter has been reviewed by Competent Authority and it has been decided that **a special drive shall be conducted by BIS to draw samples of Packaged Drinking Water**. Samples so drawn shall be tested by BARC, Mumbai for requirement of Bromate only. The matter will be coordinated by CMDII(L) in BIS.

The following course of actions has been decided:

i. **Collection of Samples**: DDGRs are requested to ensure collection of 20 samples (exact) by the BOs under the RO with as far as possible equitable distribution of samples amongst the BOs for which separate directive shall be issued by DDGR to the BOs. The sample shall be from the latest batch available in the market. DDGRs shall also monitor that brands which are easily available are not drawn more than once from the region. BOs shall draw 2 X 500ml or 2 X 1 ltr samples only, properly sealed, tagged and **adequate care is taken by BO for preventing damage/leakage of sample(s) during transit**. BOs shall despatch the sample(s) directly to **Dr (Mrs) G G Pandit**, Head, EMAS, BARC Mumbai **by 12 Feb 2015** at the address given below:

Dr (Mrs) G G PANDIT,
Head, EMAS,
BARC, Trombay,
Mumbai 400 085,
Maharashtra.
Ph: 022-25590233, Fax: 022-25505313,
E.mail*: ggp@barc.gov.in

ii. **Despatch of Samples**: A mail shall be sent to BARC, Mumbai at the above e-mail address* as soon as the sample(s) are despatched with all despatch details for tracking in the format at Annex-B with copy to PCO(RO) & CMDII(L) **by 13 Feb 2015.** A forwarding letter shall accompany all the samples as per the format at Annex-C.

ROs shall coordinate with Dr (Mrs) G G Pandit of BARC, Mumbai about confirmation of receipt of all samples of its regions and a **confirmation/status report about the**

same shall be sent through e-mail to Coordinator at CMDII(L) by 20 Feb 2015 in the format at Annex-B.

iii. **Testing of Samples**: BARC, Mumbai shall be requested to send all reports to CMDII(L) where Sh P S Yadav, Scientist-E, CMDII(L) shall coordinate on behalf of BIS.

This is issued with the approval of Competent Authority, for strict compliance by all concerned.

(Subhadip Basu)
Sc-D

HCMDII(L)

DDG(Cert) -on tour

All DDGRs

Copy to: **All BOs**

All PCO(R)s- for proper monitoring on the issue.

ITS- for hosting on BIS Intranet

Annex-A

Oxyhalide disinfection by-products in packaged drinking water and their associated risk

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Disinfection by-products (DBPs) are formed during treatment of water for drinking purposes. Among these oxyhalide DBPs, viz. bromate, chlorate and chlorite are potentially harmful to humans. In the present study packaged drinking water samples of various commercial brands, available in Mumbai, were analysed for bromide, bromate, chlorite and chlorate ions using ion chromatography. The average concentration levels of bromide, bromate, chlorite and chlorate in packaged drinking water were 28.4, 10.7, 7.1 and 20.8 μg/l respectively. Bromate in 27% samples was found to be higher than the World Health Organization (WHO) guideline value of 10 μg/l, whereas chlorite and chlorate levels were well within the guideline value recommended by WHO. A good correlation between bromide and bromate ($r = 0.85$) indicated formation of bromate from bromide present in drinking water. Health risks (carcinogenic risk and hazard quotient) associated with ingestion of bromate, chlorite and chlorate present in packaged drinking water are presented and discussed.

Keywords: Bromate, chromatography, disinfection by-products, packaged drinking water, water treatment

DISINFECTION is a part of the treatment process in which pathogenic organisms are eliminated by chemical (chlorination/ozonation treatment) and physical (UV irradiation) agents. During this process disinfection by-products (DBPs) are formed when the disinfectants used react with halides and/or the natural organic matter present in raw water. The inorganic 'oxyhalide' group of DBPs include bromate, chlorite and chlorate. These oxyhalide DBPs are known to cause significant health risks, even at low (μg/l) levels in drinking water. Bromate (BrO_3^-) is identified as a potential carcinogen and World Health Organization (WHO) recommended a guideline value of 10 μg/l for bromate in drinking water[1]. Chlorite and chlorate have shown to cause hemolytic anaemia in the laboratory studies on animals[2]. WHO has stipulated a guideline value of 700 μg/l for both chlorite and chlorate in drinking water.

Packaged drinking water is a popular alternative to water from public drinking water supply in India. Many brands of packaged drinking water are available in the country and its market is growing rapidly. The contaminant levels in packaged drinking water in India are regulated by the Bureau of Indian Standards (BIS), which gives an Indian Standards Institute (ISI) mark for meeting the regulatory limits. In general, raw water used for production of packaged drinking water is derived from groundwater using bore wells and from public drinking water supply system. BIS suggested treatment methodology for packaged drinking water includes pressure sand filtration, activated carbon filter, reverse osmosis, ozonation and UV treatment[3]. BIS has recommended standards for packaged drinking water in its document IS 14543. The recommended standards include concentration-based limits for physical (colour, taste, turbidity, etc.), chemical (trace and toxic elements, ions, etc.) and radioactive (alpha and beta emitters) parameters. However, for bromate, chlorite and chlorate standards are not recommended by BIS.

In view of the above, a study has been carried out with an objective to determine bromate, chlorite and chlorate in packaged drinking water in different commercial brands available in Mumbai. This study would be useful for regulatory agencies to recommend standards for the above oxyhalide DBPs that are present in drinking water. Also, an attempt has been made to estimate carcinogenic and non-carcinogenic (hazard quotient) risks associated with ingestion of these oxyhalide DBPs.

Bromate is formed during disinfection of water containing bromide with ozone. When bromide containing water is treated with ozone, bromide is oxidized to hypobromous acid (HOBr) and dissociation of acid results in the formation of hypobromite (OBr^-). Hypobromite ion further reacts with ozone to form bromate. This reaction is favoured at higher pH values.

$$Br^- + O_3 + H_2O \rightarrow HOBr + O_2 + OH^-, \quad (1)$$

$$HOBr + H_2O \rightarrow H_3O + OBr^-, \quad (2)$$

$$OBr^- + 2O_3 \rightarrow BrO_3^- + 2O_2. \quad (3)$$

Bromate is also formed by photochemical oxidation of bromide ions in chlorinated water[4]. Also, when water containing bromide and residual chlorine undergoes UV processing bromate is formed[5]. Under certain conditions bromate is also formed in concentrated hypochlorite solutions used for disinfection of drinking water[6]. Formation of bromate in water depends upon a variety of water quality and operational parameters such as bromide concentration, pH, concentration of dissolved organic matter, contact time, dosage of disinfectant, etc. Bromate once formed in aqueous solution is highly stable at room temperature, does not volatilize and will not be removed by boiling[7].

Chlorite and chlorate are formed during ozonation of chlorine present in water[8]. Residual chlorine reacts with water to form hypochlorous acid (HOCl). HOCl further

*For correspondence. (e-mail: ggp@barc.gov.in)

Annexure-B

Format for sending report to BARC/CMDII(L)

To be filled in by Branch office of BIS (to be sent by 13/02/15)							To be filled by RO of BIS- to be sent on 20/02/15)	To be filled in by BARC			To be filled in by CMDII(L)	
Name of Branch Office	Sample code	Licence no	Brand	Mfrs Name & Address, B.No, DOM & DOExp	Date of despatch (DD/MM/YY)	Courier Tracking details	Status of Receipt of Samples by BARC Mumbai	Date of receipt by BARC (DD/MM/YY)	Date of Issue of report by BARC (DD/MM/YY)	Test Report number	Date of receipt of Report by CMDII(L) (DD/MM/YY)	Remarks on results issued by BARC

BARC Coordinator details:

Dr (Mrs) G G PANDIT,
Head, EMAS,
BARC, Trombay,
Mumbai 400 085, Maharashtra.
Ph: 022-25590233, Fax: 022-25505313
E.mail: ggp@barc.gov.in

BIS Coordinator details:

Sh P S YADAV,
Scientist-E & Co-ordinator,
Central Marks Department-II(Legal),
9 Bahadur Shah Zafar Marg, New Delhi 110009.
Mob- 09818958299
E.mail: cmd2@bis.org.in

Annex-C (Format for letter to be enclosed alongwith sample reaching BARC)

Ref:
Dated:

To,
Dr (Mrs) G G PANDIT,
Head, EMAS,
BARC, Trombay,
Mumbai 400 085,
Maharashtra.

Subject: Analysis of Bromate in Packaged Drinking Water Samples.

Dear Sir,
This refers to the decision taken by BIS to test samples at your end for the quantitative analysis of Bromate in samples of Packaged Drinking water being sent by this office. The sample details are given below:

Name of Branch Office	Sample code	Quantity, B.No, DOM & DOExp	Lic no, Brand, Manufacturers name & Address	Courier Tracking details

You are requested to kindly analyse the samples and send the Test Reports to the Co-ordinator for the project. Charges, if any, relating to the analysis will be ensured by the coordinator whose details are given below, accordingly all details may please be sent to the coordinator:
Sh P S Yadav,
Scientist-E & Co-ordinator,
Central Marks Department-II(Legal),
9 Bahadur Shah Zafar Marg,
Delhi 110092.
Mob- 09818958299

An early action will be highly appreciated.

Thanking you,

Yours faithfully,

(IO issuing the letter with all details & Mob no)