# CPDW project

# Assessment of effect of high level of disinfectants on products in contact with drinking water

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# Assessment of effect of high level of disinfectants on products in contact with drinking water

Development of a harmonised test to be used in the European Acceptance Scheme concerning CPDW

European Commission

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## FOREWORD

The investigations described in this report were conducted as part of the European Project 'Development of harmonised tests to be used in the European Approval Scheme (EAS) concerning Construction Products in Contact with Drinking water (CPDW)', under Contract no. EVK1-CT2000-00052. The European Commission, various national authorities and material suppliers, financially supports this project respectively. Work Package 4 of this project concerned the assessment of effect of high level of disinfectants on products in contact with drinking water. The institutes participating in the investigations in WP4 are listed below.

This report describes the experimental results as obtained in WP4 of the project. The reports of the participants about their observations in the various project stages have been collected in a separate appendix.

This project was carried out by six institutes, represented by the following staff:

| | |
|---|---|
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**SUMMARY**

This report is related to the WP4 «Disinfection by-products» as a part of the European Project "Development of harmonised tests to be used in the European Approval Scheme (EAS) concerning Construction Products in Contact with Drinking Water (CPDW), under contract n° EVK1-CT2000-00052.
The objectives of this research were first to complete a review of the use of high levels of disinfectants applied to water distribution systems in Europe, then to obtain experimental data concerning the migration rate under different disinfection conditions for a range of the representative CPDW commonly used in Europe and finally to give guidance to the regulators about the need to include a simulation of high levels of disinfection in the European Acceptance Scheme (EAS).
In the majority of Member States (MS), high levels of chlorine are applied to CPDW in the water distribution systems, in order to prevent or to remove microbial contamination. Hydrogen peroxide is also used in response to environmental issues. Potassium permanganate is used inside buildings in some MS.
Regulations or practical guidelines for disinfection procedures are available in most of the MS, mainly in public networks. Few MS have regulations for application inside building and in case of Legionella contamination. Nevertheless, the implementation of the European Directive DWD 98/83/EC including microbial requirements at the consumer tap, will lead the MS to develop guidance for disinfection inside buildings.

The experimental part of the WP4 included a testing programme: a range of organic products were preliminarily exposed to different disinfection procedures (chlorine and hydrogen peroxide under several contact times and concentrations) and the migration rate was compared with the same materials not exposed to disinfectants.
The products to be studied were chosen taking into account their main uses in European water distribution systems application (PVC-U, HDPE, EPDM, epoxy and polyester resins, cement with organic additive). The choice of significant parameters was based on the experience of the participants and on existing national requirements (odour, flavour, TOC, haloforms and other organic micro-pollutants). Supporting standards or draft standards produced by CEN/TC164/WG3 "Materials in Contact with Drinking Water" were used for this work in order to produce migration water.

Six European Institutes have participated in WP4. All were involved in water analysis and four of them were national laboratories for testing materials in contact with drinking water. The test results showed clearly that there was no significant difference attributable to the different disinfectant solutions and contact times, and no difference when the products were not in contact with disinfectants. The research permitted a good transfer of experience between these laboratories, and also permitted to make proposals for the next EAS assessment. These proposals to RG-CPDW are:

- not to include high levels of disinfection in the general test procedure applied to CPDW for EAS logo, except for new products,
- to include in EAS a list of significant chemical parameters (odour, flavour, TOC, GC-MS technique analysis).
- to include inter-laboratories exercises in the future in order to increase the inter-laboratory comparability of the results. Some parameters showed a low reproducibility between laboratories.

## CONTENTS

## INTRODUCTION

In most of the fifteen European Member States (MS), the use of Construction Products intended for contact with Drinking Water (CPDW) is regulated by National Acceptance Schemes (NAS) in order to protect the consumer against the potential adverse effects of these products on drinking water quality.

The MS differ significantly in their approach and in their organisation for NAS. The existence and the role of National Regulatory Bodies (NRB), and of Toxicity Committees are different, and the acceptance procedure (use of positive lists, migration tests, acceptance criteria, etc.) is not the same in the MSs. Thus, these NAS constitute a barrier to trade for the products in the European Community. A product can be approved in one Member State and disapproved in another Member State. There is no real open market and free circulation of the products. A manufacturer wishing to sell his products all over Europe needs to submit them to the different existing NAS. Moreover, it is costly and difficult to understand each national regulatory approach.

In 1989, CEN/TC164/WG3 "Water Supply – Effects of materials in contact with drinking water" was created and European test procedures are currently under development Some ENs are already available, but the progress has been very slow due to the relation between test conditions (test methodology) and acceptance criteria (regulatory aspects). These acceptance criteria include parameters to be assessed and acceptance levels for each parameter. They are closely related to the implementation of the Drinking Water Directive (DWD 98/83 /EC).

The use of CPDWs must meet the requirements of DWD, but is also related to the Construction Products Directive (CPD 89/106/EC).

In order to resolve these issues, the MS requested DG Enterprise to create a new European structure able to produce European Regulations for CPDW. After a preliminary "Feasibility Study" carried out by four MS, presentation of the report to Standing Committee of Construction (SCC), and with the agreement of the fifteen MS, the SCC decided in 1999 to create the Regulators Group on Construction Products in contact with Drinking Water (RG-CPDW). This body is composed of members from the Standing Committee for Drinking Water (SCDW) and the Standing Committee of Construction (SCC), CEN, national regulators and their experts and observers from European Industry. The task of RG-CPDW is to produce a prototype European Acceptance Scheme (EAS) that will permit the free circulation of construction products for use with drinking water throughout Europe, without any barrier to trade and provide a comparative level of customer protection.

Soon after its creation in 1999, RG-CPDW accepted the tests developed by CEN (some EN or prEN Standards) but also identified the need for a research on other complementary or fundamental aspects of testing of these products in order to complete the EAS. This research project was accepted and funded (50%) by the Commission (DG Research), with the other 50% being funded by the MS (materials manufacturers, water distributors, ministries, etc.). The research project started on 1st March 2001 and consisted of four work packages, microbial growth, cytotoxicity, unsuspected substances detected by GC-MS analysis and disinfectant by-products.

## OBJECTIVES OF WP4 "DISINFECTANTS BY PRODUCTS"

*The Drinking Water Directive 98/83/EC* intends to protect the water quality at the consumer's tap, so, beyond the effect on water quality of public water distribution systems, the effect of domestic installations also needs to be considered.

The following new aspects of the DWD have consequences for CPDW:

- more stringent requirements on lead, nickel and copper,
- introduction of parameters related to organic materials such as vinyl chloride monomer, epichlorohydrin and acrylamide,
- new products, such as copolymers, composites are now used to replace domestic or service lead pipes,
- greater consideration for microbial parameters at the consumer tap.
- risk of contamination by Legionella in hot water distribution systems inside buildings.

The need for regular disinfection of the water networks clearly appeared. Indeed, in many cases, the poor microbial quality of drinking water is caused by inadequate maintenance of drinking water distribution systems. The consequence is that treatment with high levels of disinfectants may be applied in order to remove microbial contamination, even in countries whose culture and tradition is to avoid the use of chlorine. Such treatments may be used both after installation and/or after renovation or repair of distribution systems. As a result the materials used in the distribution systems are exposed to disinfection procedures. Therefore it is very important to know how materials may react when exposed to high levels of disinfectants and to predict their potential to form disinfectant by-products due to the chemical reactions or even degradation.

Some Member States including France already have national regulations or approval procedures for CPDW test conditions, which simulate high level of disinfection (HLD). This means that all the materials approved in France for contact with Drinking Water have been submitted to a 24 hours contact time with 100 mg/l chlorine, without leaching significant by-products. This is not the case for other Member States that may not consider the performance of materials with HLD.

After discussion within CEN/TC164/WG3, a consensus was achieved to include an optional simulation of disinfection procedure in the standards or draft standards:

- "Organoleptic Assessment of organic materials in piping systems": EN 1420/1, EN13052/1,
- "Organoleptic Assessment in organic materials in storage systems": prEN14395/1
- "Migration assessment prEN12873/1 and prEN12873/2

At the moment, this procedure (HLD) is included in these test procedures (contact with 50 mg/l chlorine for 24h) as a possible preliminary stage of testing, but to be applied according to the product standards and/or national regulations.

The results of WP4 research will allow the RG-CPDW to make a decision about the need to include this procedure in the tests required to obtain the EAS "logo".

The task of this WP4 is not only to compare the performance of different types of materials after contact with one high level of chlorine, but also to submit these materials to different disinfection conditions including chlorine and hydrogen peroxide. The results will lead to improve knowledge on potential disinfection by-products, and to the optimisation of the disinfection procedure in order to avoid possible adverse interactions with the materials

degradation. Note that WP4 has not considered the effects of low concentrations of disinfectant (for example 1 mg/l of chlorine) used to treat drinking water.

The WP4 research program was carried out over two years in four stages:
Stage 1: review of disinfection practices in Europe
Stage 2: testing disinfection procedures on CPDW,
Stage 3: validation and statistic interpretation of the results,
Stage 4: scheme to include in EN standards and proposals for EAS to RG-CPDW

Six European Institutes have participated in this WP4. All were involved in water analysis and four of them were national laboratories for testing materials in contact with drinking water. They all participated in stage 1 and stage 2. The co-ordinating Institute (CRECEP) mainly performed stages 3 and 4.

This report relates to the results of Stage 2 on the comparison of various high level disinfection conditions and application of no disinfection on odour and taste, and migration of substances.

## TESTING DISINFECTION PROCEDURE ON CPDW

*General*

Representative CPDW were subjected to a *range of disinfection conditions* in order to assess their potential to form disinfection by-products. A range of *chlorine and hydrogen peroxide concentrations and contact times* was investigated.

Appropriate EN and prEN Standards of interest for assessing the inertness of materials in contact with drinking water were used to obtain migration waters from the test materials and to perform the relevant measurements using either:

- high levels of disinfection treatment
- no disinfection treatments.

The organization of the trials (choice, sampling, sending of materials/products samples, and then collection, circulation of the results) was decided during four meetings of the participants, and technical procedures, presentation of results, etc. were exchanged by E-mails.

*Tested materials*

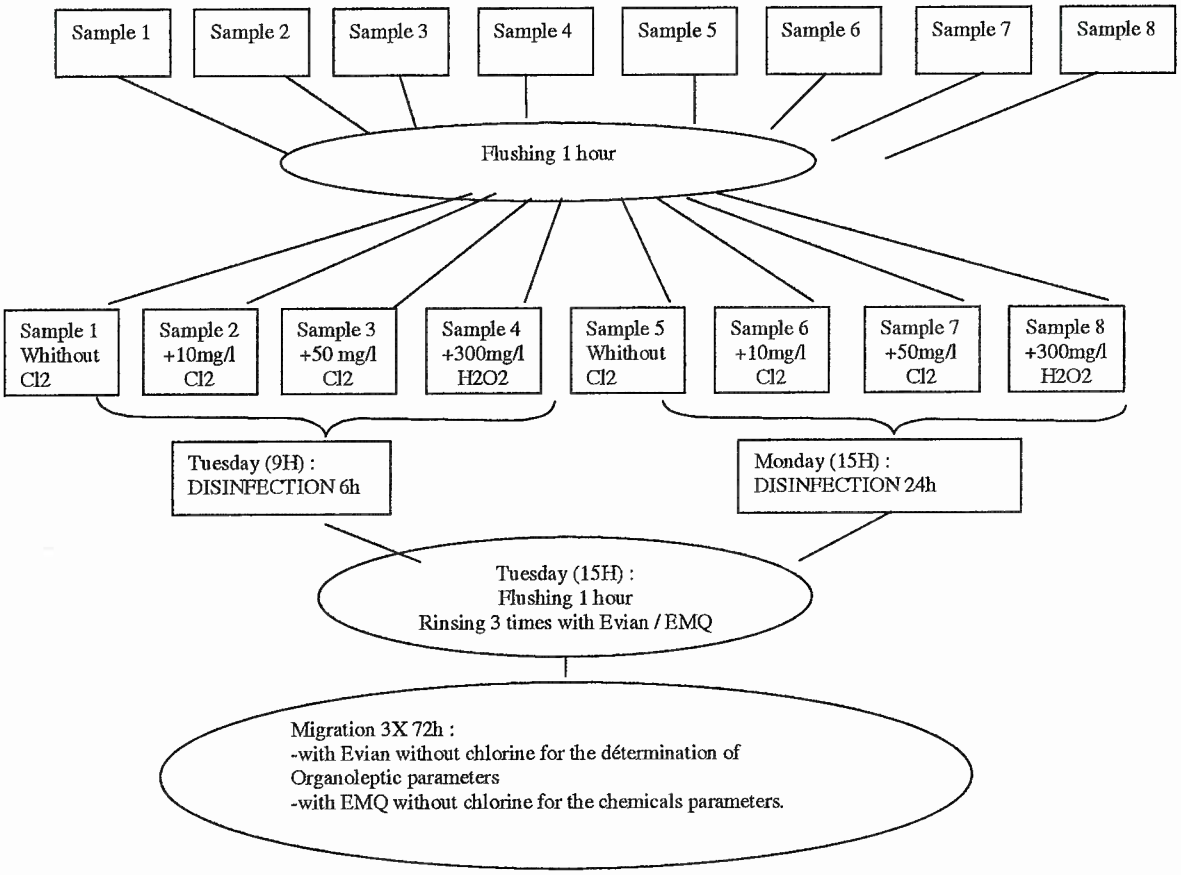
The trials were performed on organic materials/products, including one cementitious product with organic additives (see table below). Metallic materials/products could not be studied due to the fact that test methods were not available during the research period. The materials/products to be studied were chosen taking into account their main uses within Member States. These materials/products samples were provided by Industry to the participating test organizations. The six materials/products were also selected on the basis of their frequent use in European water distribution systems and their presumed sensitivity to disinfectants.

The range of materials/products was sent to the participants during the period June 2001 to June 2002. The trials started in June 2001 and finished in October 2002. A consensus was obtained about the choice of provider institutes in charge of sending the other institutes the materials samples. Industry actively participated to the production of materials/products samples. Each material was tested singly by three of the participants.

| Product | Details | Provider | Participating Labs | Period |
|---|---|---|---|---|
| PVC-U | Pipe<br>$d_n$ = 63 mm | EPAL | EPAL, TWUL, TZW | June 2001<br>October 2001 |
| PE-HD | Pipe PE80<br>$d_n$ = 32 mm | KIWA | KIWA, ISS, CRECEP | June 2001<br>October 2001 |
| EPDM rubber | Flexible hose<br>d = 25/17 mm | TWUL | TWUL, ISS, TZW | May 2002<br>July 2002 |
| Epoxy coating | Plates<br>Size = 4 x 12.5 cm<br>S = 100 $cm^2$ | CRECEP | TWUL, EPAL, KIWA | June 2002<br>August 2002 |
| Cement | Acrylic polymer additive<br>Block<br>Size = 4 x 4 x 16 cm<br>S = 280 $cm^2$ | CRECEP | CRECEP, EPAL, ISS | May 2002<br>July 2002 |
| Polyester | Plate<br>Size = 4 x 12.5 cm<br>S = 100 $cm^2$ | Swedish manufacture | CRECEP, TZW, KIWA | May 2002<br>July 2002 |

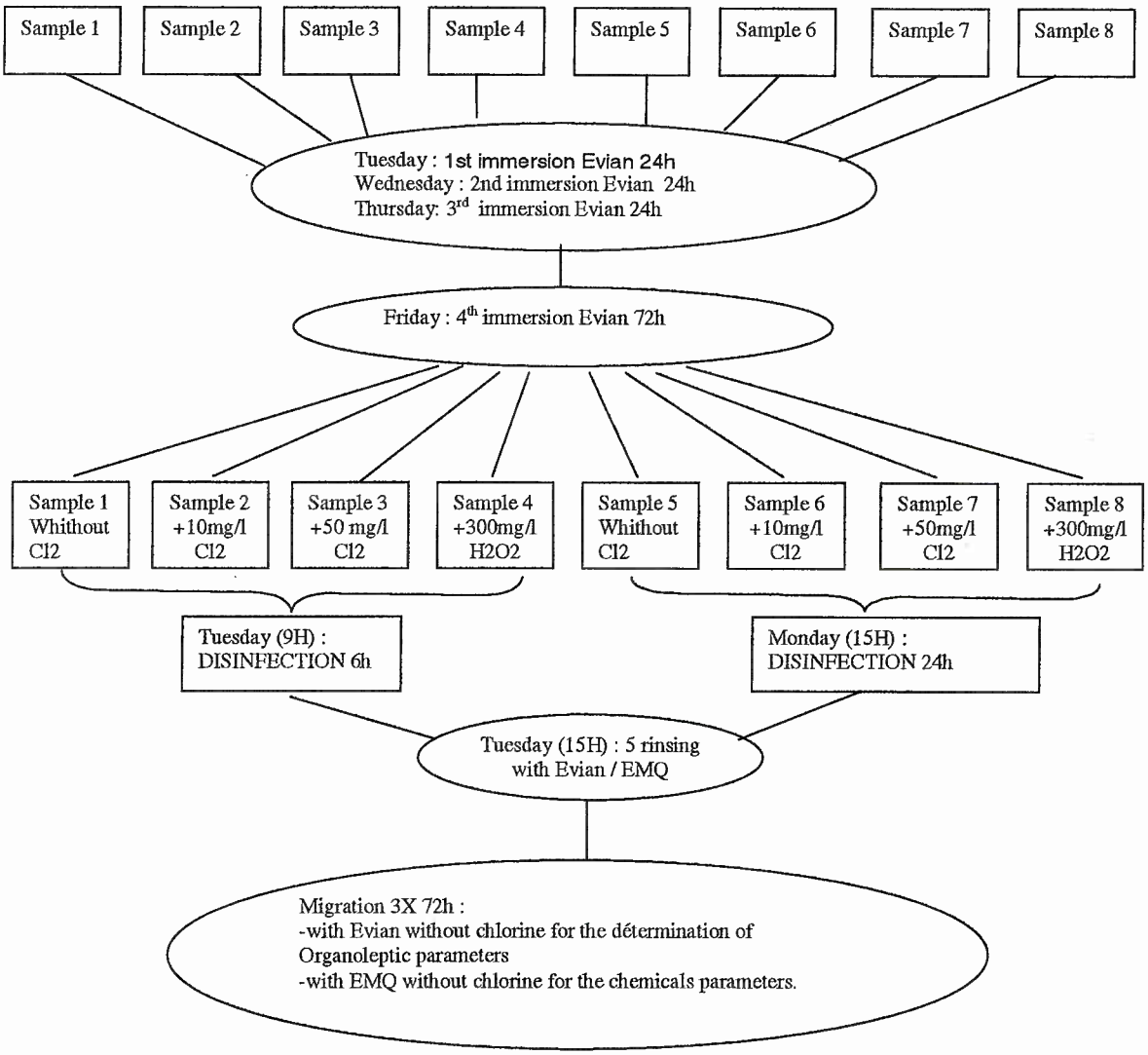
*Preparation of test migration waters*

Supporting standards produced by CEN/TC164/WG3 either as ENs or as draft standards (prENs) were used for this work. For organic piping products such as HDPE, PVC pipes, EPDM flexible hoses, epoxy resin EN 1420/1 was used to prepare the migration water for organoleptic assessment and prEN 12873/1 for substance migration assessment. For storage systems such as polyester resin prEN 14395/1 was used to prepare the migration water for organoleptic assessment and prEN12873/1 for substance migration assessment. A schematic presentation of the procedure for organic products (HDPE, PVC, EPDM, epoxy and polyester resins) is presented in the figure below.




For the cementitious product, a *draft* test method available from CEN/TC164/WG3/AHG6 was used. This included a specific preconditioning procedure before the migration procedure in order to stabilize the product, based on the conclusions of a previous co-normative research carried out on cementitious products [1]. A schematic presentation of the procedure is presented in the figure below.

[1] Leroy P., Rigal S., Baron J., Van den Hoven Th., Slaats N., Morlot M., Autugelle C., Wagner I., Werner W., Oliphant R., Conroy P., Miller R., Quevauviller Ph., Co-normative research on test methods for materials in contact with drinking water, EUR 19602 (2000)




*Surface to volume ratio*

These were chosen in accordance with the information given in prENs or ENs, and expressed in $dm^2/dm^3$ or $dm^{-1}$. For organoleptic assessment, realistic S/V conditions were used with no conversion factors applied to the results and for migration assessment high S/V conditions were used and conversion factors applied to the results (see table below).

| *Product* | *Organoleptic assessment* | *Migration assessment* |
|---|---|---|
| HDPE pipe | pipe filled with water | pipe filled with water |
| PVC pipe | pipe filled with water | pipe filled with water |
| EPDM rubber | 0.4 $dm^{-1}$ | 5 $dm^{-1}$ |
| Epoxy coating | 1 $dm^{-1}$ | 5 $dm^{-1}$ |
| Polyester | 1 $dm^{-1}$ | 5 $dm^{-1}$ |
| Cement with organic additive | 2.8 $dm^{-1}$ | 5.6 $dm^{-1}$ |

*Disinfection procedures*

Disinfection contact procedures were carried out before the procedure to prepare the migration water. It consisted of a contact time for 6 or 24 hours with either chlorinated water (10 or 50 mg/l free chlorine) or water with hydrogen peroxide (300 mg/l). The experiments including a disinfection procedure were compared to those without disinfection.

| *Contact time* | *NaClO* | | | *$H_2O_2$* |
|---|---|---|---|---|
| h | mg/l free chlorine | | | mg/l |
| 6 | 0 | 10 | 50 | 300 |
| 24 | 0 | 10 | 50 | 300 |

*Migration procedure*

After the completion of disinfection procedure, each material/product sample was rinsed and then submitted to three successive migration periods of 72h in test waters without chlorine according to EN 1420/1 or prEN 14395 for organoleptic assessment and to prEN 12873/1 for migration.

*Analysis performed in migration waters*

The choice of the significant parameters was based on the experience of the participants and on existing requirements for materials intended for contact with drinking water, in some Member States. For odour and flavour EN 1622 was used, for THM EN10301, for AOX EN 1485 and for TOC EN 1484. For GC/MS no EN or prEN is available and assessment was studied within WP3 "Non-suspected Substances by GCMS" of this research project. Their conclusions were not available yet for WP4. So, two national standards have been used, i.e. BS 6920 part 4 from United Kingdom or X PP 41250 part 2 from France.

All three 72h migration waters were analysed for odour, flavour and TOC. The third 72h migration water was additionally analysed for AOX, THM and GCMS. The tests were performed in single.

## TEST RESULTS

The test results are presented in tables in the annexes according to the material studied. Individual reports of the materials per institute are reported in a separate document, which is an annex to this report.

## VALIDATION AND STATISTIC INTERPRETATION OF RESULTS

*Description of the statistic method*

A statistic interpretation of results was performed in order to try to help draw conclusion. This statistic method was done by paired samples series test, which is a non-parametric statistics. Non-parametric statistics is a collective term, giving to methods of hypothesis testing and estimation that are valid under less restrictive assumptions than classical methods. For example, the classical analysis of variance tests require the assumption of normal distributions with equal variances, and the non-parametric counterparts require only the assumption that the samples come from continuous populations. Also, classical statistical methods are strictly valid only for data measured on at least an interval scale, while non-parametric statistics apply to data measured on a nominal scale or ordinal scale (rank data). Since interval-scale data can be reduced to ordinal or nominal scale, non-parametric methods can be used whenever classical methods are valid; the reverse is not true. Thus, non-parametric statistics can legitimately be used in a very wide range of practical situations, and the interferences reached need not be tempered by qualifying statements such as "if the assumption is true, then ...".
Non-parametric methods are frequently called distribution-free methods, because the inferences are based on a test statistic whose sampling distribution does not depend on the specific distribution of the population from which the sample is drawn.
Most of the methods were originally proposed in the late 1940s and early 1950s. Many articles that have appeared later develop properties, modifications, refinements, and extensions of the basic procedures as well as new procedures. Considerable research is still being devoted to this topic.

*Test for one sample and paired sample*

Assume that $x_1$, $x_2$, ...$x_n$ are a random sample of n observations measured on at least on ordinal scale and drawn from a continuous population with unknown median M. We want to test the null hypothesis
H: $M = M_0$
If the null hypothesis is true, about half of the observations in the sample should be larger than $M_0$. The ***sign test statistic*** is defined as the number of plus sign S among the n differences $x_1–M_0$, $x_2–M_0$, ..., $x_n–M_0$. The null distribution of S is the binomial distribution with n and S = 0.5, which is given for $n \leq 20$ in a table. For larger sample sizes, we can use the normal approximation to the binomial distribution with the test statistic z.
The ±0.5 term is a continuity correction introduced to improve the normal approximation to the binomial. If any of the differences $x_i–M_0$ are equal to zero, they should be ignored, and then n is reduced accordingly.
The usual non-parametric approach is to report the P value, that is the probability under H of obtaining a sample result as extreme as that observed in a particular direction, as indicated by the one-sided alternative. In general, the decision rule using P values is to reject H for any $P \leq$ alpha and not to reject H otherwise. Alternatively, we can simply report the P value and not chose a particular value of alpha. If the alternative is two-sided as:

A: $M \neq M_0$
The common practice is to report either twice the smaller one-tailed P value or 1, whichever is smaller.
For paired samples, the same procedure can be used to test the null hypothesis
H: $M_D = M_0$
Where $M_D$ represents the median of the population of differences X–Y. In this kind of application, S is defined as the number of plus signs among the n differences $x_1-y_1-M_0$, $x_2-y_2-M_0$, …, $x_n-y_n-M_0$
Now we return to the same one-sample situation but suppose that we are willing to assume that the population is symmetric about its median. If the null hypothesis H: $M = M_0$ is true, then we expect not only that about half of the sample observations will exceed $M_0$ but also that the magnitudes of those larger than $M_0$ will about balance off the magnitudes of those smaller than $M_0$. The appropriate procedure here then is to rank the absolute values $|x_1-M_0|$, $|x_2-M_0|$, …, $|x_n-M_0|$ from 1 to n, keeping track of the original signs. The sum of the positive ranks (ranks which are originally positive difference) should be about equal to the sum of the negative ranks under H. However, since two sums add up to a constant, either one can be used as a test statistic by itself. The ***Wilcoxon signed rank test*** statistic is defined as either T+ (= sum of positive ranks) or T- (= sum of the negative ranks). T+ and T- are identically distributed under the null hypothesis. This distribution is given in a table. The Wilcoxon signed rank test can be used in exactly the same way for paired samples.
In general, if either test can be used, the Wilcoxon signed rank test is preferred if the symmetry assumption appears reasonable. The asymptotic relative efficiency of the Wilcoxon signed rank test relative to Student's t test is at least 0.864 for any continuous, symmetric distribution, compared with only 0.333 for the sign test.

*Results of statistical evaluation*
Due to the limited number of identical test conditions, the only possible statistic test to apply was a paired samples series tests. Two tests were applied, sign test statistics and sign rank test statistic. The conclusions of these two tests need to be homogeneous to be valid. These tests were applied to each of the exploitable parameter for tested material and in accordance with four variables: range of extraction, laboratory, type of disinfectant, and stagnation time.
When the range of stagnation was studied, the results of three extractions were compared pair by pair. When the influence "laboratory" was studied, laboratory results were compared pair by pair for each of the three extractions. This procedure corresponds to a laboratory differences assessment. The parameter "disinfectant" was tested on the basis of binary concentrations between the chlorine concentrations and chlorine/hydrogen peroxide concentrations. When possible, the two stagnation times were compared for each disinfectant concentration. The most reliable statistic conclusions were obtained when the full range of values was available, since than the number of values was large enough.

- In many cases (mainly for PVC pipe), the absence of some data over the quantification limit did not allow the interpretation of results for all the studied materials,
- In other cases, where, despite the values being over the quantification limit, these values were either too close or too contradictory, so, in these cases, the results were not usable. Sometimes the results of the two statistic tests were contradictory, one giving a significant difference, and the other test giving no significant difference. If the P value referred in the table was not clearly over or lower than 0.05 (at least factor 2 or 3), no reliable conclusion was possible. If one of these two P values is clearly upper or lower than 0.05, the conclusion of the test related to this P value must be considered,
- Where the usable data only concerned one laboratory, and few data were available (for example comparison of stagnation times), the test was not applicable.

In most of other cases, the conclusions need to be considered cautiously. In the end it can be concluded that:

- The test results did not show any consistent and significant differences attributable to the different disinfectant solutions and contact times
- The results for TOC, THMs and AOX showed good agreement between the participating laboratories. No significant concentrations of either THMs or AOX were found in any of the materials leachates
- For the GC-MS scan it was difficult to draw a conclusion about agreement between the participating laboratories
- In the case of odour and flavour assessments both quantitative (dilution) and qualitative (odour/flavour descriptions) differences were seen between participating laboratories. These results reinforce the importance of taking due care in determining future test requirements/pass or fail criteria for both odour (TON) and flavour (TFN) assessments of material leachates

## CONCLUSION AND PROPOSALS

The task of this WP4 "Disinfection by-products", as a part of the research project EVK1–CT2000-00052 was to allow the RG-CPDW to make a decision about the need to include a contact of CPDW with high levels of disinfectants in the tests required to obtain the EAS logo.

Three main conclusions:

- the review of disinfection practices in Europe clearly showed that most of the Member States apply high levels of disinfectants in order to avoid or to remove microbial contamination,
- the test results showed clearly that there was no significant difference attributable to the different disinfectant solutions and contact times,
- other unexpected benefit of this research was the collection of migration values obtained from CPDW when tested according to existing ENs or prENs. These data will help to give guidance to RG-CPDW in setting acceptance values.

The proposals to RG-CPDW for EAS are:

- In general, a procedure to test the effect of high levels of disinfection is not relevant for the EAS
- Nevertheless, such test as described in the existing ENs could be requested for acceptance of new materials/products. In that case, assessment of odour and flavour, TOC and GC-MS of non-suspected substances are recommended

**ANNEX – PVC-U**

*PVC-U – odour*

| Extraction no. | TWUL 1st | TWUL 2nd | TWUL 3rd | EPAL 1st | EPAL 2nd | EPAL 3rd | TZW 1st | TZW 2nd | TZW 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | | | |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1 C* | 1 | 1 | 1 | 1 | 1 | 1-2 R | 1 | 1-2 R |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 3 (Musty) | 3 (n.i.) | 2 (n.i.) | 1 | 1-2 R | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 C* | 1 | 1 | 2 (n.i.) | 1 | 1 | 1 | 1 | 2 R |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 3 (n.i.) | 3 (unpleasant) | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1-2 R | 1-2 R |

n.i., not identified; C, chemical; R, rotten

* 1 detected in first dilution (reported by one assessor only)

*PVC-U – flavour*

| Extraction no. | TWUL 1st | TWUL 2nd | TWUL 3rd | EPAL 1st | EPAL 2nd | EPAL 3rd | TZW 1st | TZW 2nd | TZW 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | | | |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 1 | 1 | 1 | 1-2 B | 1 | 1-2 B |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1-2 B | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1-2 B | 1-2 B |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 3 (Musty) | 3 (n.i.) | 1 | 1 | 2 B | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 2 (n.i.) | 1 | 1 | 1 | 1-2 B | 1-2 B |
| 10 mg/l $Cl_2$ | 1 | 1 C* | 1 | 3 (n.i.) | 2 (astringent) | 1 | 1 | 1-2 B | 1-2 B |
| 50 mg/l $Cl_2$ | 1 | 1 C* | 1 | 1 | 1 | 1 | 1 | 1-2 B | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 2 (sweet) | 1 | 1 | 1 | 2-4 B | 1-2 B |

n.i., not identified; B, bitter; C, chemical; R, rotten

* 1 detected in first dilution (reported by one assessor only)

*PVC-U – TOC*

| Extraction no. | TWUL 1st mg/l | 2nd mg/l | 3rd mg/l | EPAL 1st mg/l | mg/dm²/d | 2nd mg/l | mg/dm²/d | 3rd mg/l | mg/dm²/d | TZW 1st mg/l | mg/dm²/d | 2nd mg/l | 3rd mg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | <0.4 | - | <0.4 | - | <0.4 | - | | | | |
| **Stagnation 6h** | | | | | | | | | | | | | |
| No disinfectant | <0.1 | - | <0.1 | - | - | - | - | - | - | <0.1 | <0.01 | <0.1 | <0.1 |
| 10 mg/l $Cl_2$ | <0.1 | - | <0.1 | 6.6 | 0.034 | 1.7 | 0.009 | 1.9 | 0.01 | <0.1 | <0.01 | <0.1 | <0.1 |
| 50 mg/l $Cl_2$ | <0.1 | - | <0.1 | 2.3 | 0.012 | 2.5 | 0.013 | 3.2 | 0.017 | <0.1 | <0.01 | <0.1 | <0.1 |
| 300 mg/l $H_2O_2$ | <0.1 | - | <0.1 | 7 | 0.036 | 1.6 | 0.008 | <1.0 | n.d. | <0.1 | <0.01 | <0.1 | <0.1 |
| **Stagnation 24h** | | | | | | | | | | | | | |
| No disinfectant | <0.1 | - | <0.1 | - | - | - | - | - | - | 0.1 | <0.01 | <0.1 | <0.1 |
| 10 mg/l $Cl_2$ | <0.1 | - | <0.1 | 3.3 | 0.017 | 0.8 | 0.004 | <1.0 | n.d. | <0.1 | <0.01 | <0.1 | <0.1 |
| 50 mg/l $Cl_2$ | <0.1 | - | <0.1 | 2.5 | 0.013 | 0.6 | 0.003 | <1.0 | n.d. | <0.1 | <0.01 | <0.1 | <0.1 |
| 300 mg/l $H_2O_2$ | <0.1 | - | <0.1 | 3.7 | 0.019 | 0.8 | 0.004 | <1.0 | n.d. | 0.2 | <0.01 | <0.1 | <0.1 |

n.d., not detected

*PVC-U – THM*

| Extraction no. | TWUL 3rd | EPAL 3rd µg/l | µg/dm²/d | TZW 3rd |
|---|---|---|---|---|
| Blank | | <1 | - | |
| **Stagnation 6h** | | | | |
| Without disinfectant | n.d. | - | - | n.d. |
| 10 mg/l $Cl_2$ | n.d. | <1 | n.d. | n.d. |
| 50 mg/l $Cl_2$ | n.d. | 3 | 0.016 | n.d. |
| 300 mg/l $H_2O_2$ | n.d. | 19 | 0.099 | n.d. |
| **Stagnation 24h** | | | | |
| Without disinfectant | n.d. | - | - | n.d. |
| 10 mg/l $Cl_2$ | n.d. | 13 | 0.068 | n.d. |
| 50 mg/l $Cl_2$ | n.d. | 11 | 0.057 | n.d. |
| 300 mg/l $H_2O_2$ | n.d. | 14 | 0.073 | n.d. |

n.d., not detected

*PVC-U – AOX*

| Extraction no. | TWUL 3rd mg/l | EPAL 3rd mg/l | TZW 3rd mg/l |
|---|---|---|---|
| Blank | | - | |
| **Stagnation 6h** | | | |
| Without disinfectant | <10 | - | <5 |
| 10 mg/l $Cl_2$ | <10 | n.d. | <5 |
| 50 mg/l $Cl_2$ | <10 | n.d. | <5 |
| 300 mg/l $H_2O_2$ | <10 | n.d. | <5 |
| **Stagnation 24h** | | | |
| Without disinfectant | <10 | - | <5 |
| 10 mg/l $Cl_2$ | <10 | n.d. | <5 |
| 50 mg/l $Cl_2$ | <10 | n.d. | <5 |
| 300 mg/l $H_2O_2$ | <10 | n.d. | <5 |

n.d., not detected

*PVC-U – GCMS*

3rd migration; TZW did not detected compounds; * the source of the chloroform in these samples is unknown, but since chloroform is not present in the tri-halo methane test results, it may have originated from the solvent used to prepare the test sample leachate extracts.

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| *Common* | | | | | | | | | |
| isobutyl phthalate (TWUL) | - | - | - | - | - | 1 | - | - | - |
| Phthalic acid, diisoobutyl ester (EPAL) | | | 0.96 | | | | | | |
| *TWUL* | | | | | | | | | |
| chloroform * | 19.1 | 14.8 | 19.9 | 21.4 | 18.6 | 18.5 | 18.7 | 18.1 | 19.9 |
| dichloroethane | 1.9 | 1.7 | 1.4 | 1.4 | 1.3 | 1.9 | 1.8 | 1.9 | 2.2 |
| cyclohexane | 6.9 | 5.4 | 4.4 | 3.7 | 3.4 | 5.7 | 5.7 | 5.8 | 6.5 |
| butanoic acid, butyl ester | 1.7 | 1.2 | - | - | - | 1.4 | 1.2 | 1.2 | 1.3 |
| hexadecanoic acid, 1,1-dimethyl ester | - | 1.6 | - | - | - | - | - | 1 | - |
| erucylamide | - | - | - | - | - | 1.4 | - | - | - |
| *EPAL* | | | | | | | | | |
| Decane | | | | | 1.55 | | 1.55 | 1.27 | 1.32 |
| Ethylhexanol | | | 0.53 | | 1.91 | | 0.95 | 0.99 | 1.44 |
| Undecane | | | | | 1.82 | | 1.92 | 1.55 | 1.60 |
| Dodecane | | | | | 4.84 | | 4.24 | 3.93 | 4.12 |
| Tridecane | | | | | 0.88 | | 0.91 | 0.71 | 0.76 |
| Hexadecane | | | | | 2.82 | | 2.81 | 2.29 | 2.45 |
| 2,4-ditert-butylphenol | 29.19 | | 0.55 | | 1.54 | | 1.34 | 1.42 | 1.31 |
| Diethyl phthalate | | | 3.06 | | | | | | |
| C1 (55, 83, 82, 111) | | | | | 2.81 | | | 3.11 | 3.17 |
| Dibutyl phthalate | | | 0.46 | | 0.82 | | 1.01 | 0.78 | |
| Diisooctyl phthalate | | | | | | | 1.63 | 0.92 | |
| Squalene | | | | | | | 2.17 | | |
| C2 (55, 54, 111, 129) | | | | | 6.96 | | 4.19 | 7.78 | 6.42 |

**ANNEX – PE-HD**

*PE-HD – odour*

| | CRECEP | | | Kiwa | | | ISS | | |
|---|---|---|---|---|---|---|---|---|---|
| Extraction no. | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| Blank (Evian) | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1 | 1.5 P | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1.5 P | 2 St | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1.5 C,Ra,So,St | 1.5 P | 1.5 P,St | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1.5 P,St | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 2 P,Ru | 3 Ra | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1.5 P | 1.5 P | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1.5 C,Ra,St | 2 P,Ra,St | 2 P | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

C, chemical; P, plastic; Ra, rancid; Ru rubber; So, solvent; St, stagnant

*PE-HD – flavour*

| Extraction no. | CRECEP 1st | 2nd | 3rd | Kiwa 1st | 2nd | 3rd | ISS 1st | 2nd | 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | 1.5 Str | 1.5 Str,B | 1.5 Str | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 3 Str,P,B | 4 Str,P,B | 2.5 Str,P | 1 | 1 | 1 | 1 | 1.5 Str | 1 |
| 10 mg/l $Cl_2$ | 3 Str,B | 4 Str,P,B | 4 Str,P | 1 | 1 | 1 | 1 | 1.5 Str | 1 |
| 50 mg/l $Cl_2$ | 5 Str,So,B | 4 Str,P,B | 4 Str,P,Sta | 1 | 1 | 1 | 3.0 P | 1 | 1.0 P |
| 300 mg/l $H_2O_2$ | 2.5 Str,So | 2.5 Str,P | 3 Str,P,B | 1 | 1 | 1 | 3.0 Str | 1.0 Str | 1.0 Str |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 3 Str,B | 4 Str,P,B | 5 Str,P | 1 | 1 | 1 | 1.5 Str | 1 | 1 |
| 10 mg/l $Cl_2$ | 3 Str,B | 5 Str, P,B | 3 Str,P | 1 | 1 | 1 | 1 | 1.0 P | 1 |
| 50 mg/l $Cl_2$ | 5 Str,So | 5 B,P,Ra,Str,Sta, | 4 Str,P | 1 | 1 | 1 | 2.5 P | 1.0 P | 1.0 P |
| 300 mg/l $H_2O_2$ | 3 Str,B | 3 Str,P | 3 Str,P | 1 | 1 | 1 | 1.5 Str | 1.0 Str | 1.0 Str |

n.d., not detected; B, bitter; P, plastic; Ra, rancid; So, solvent; Sta, stagnant; Str, stringent

*PE-HD – TOC*

| Extraction no. | CRECEP 1st mg/l | 2nd mg/l | 3rd mg/l | Kiwa 1st mg/l | 2nd mg/l | 3rd mg/l | ISS 1st mg/l | mg/dm²/d | 2nd mg/l | mg/dm²/d | 3rd mg/l | mg/dm²/d |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blank | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.09 | 0.002 | 0.11 | 0.002 | 0.12 | 0.003 |
| **Stagnation 6h** | | | | | | | | | | | | |
| No disinfectant | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.09 | 0.002 | 0.14 | 0.003 | 0.13 | 0.003 |
| 10 mg/l $Cl_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.10 | 0.002 | 0.17 | 0.004 | 0.22 | 0.005 |
| 50 mg/l $Cl_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.11 | 0.002 | 0.11 | 0.002 | 0.22 | 0.005 |
| 300 mg/l $H_2O_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.10 | 0.002 | 0.11 | 0.002 | 0.20 | 0.005 |
| **Stagnation 24h** | | | | | | | | | | | | |
| No disinfectant | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.12 | 0.003 | 0.13 | 0.003 | 0.20 | 0.005 |
| 10 mg/l $Cl_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.15 | 0.003 | 0.18 | 0.004 | 0.12 | 0.003 |
| 50 mg/l $Cl_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.12 | 0.003 | 0.19 | 0.004 | 0.21 | 0.005 |
| 300 mg/l $H_2O_2$ | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | < 0,2 | 0.09 | 0.002 | 0.17 | 0.004 | 0.12 | 0.003 |

n.d., not detected

*PE-HD – THM*

| Extraction no. | CRECEP 3rd µg/l | Kiwa * 3rd µg/l | ISS 3rd µg/l | µg/dm²/d |
|---|---|---|---|---|
| Blank | n.d. | n.d. | 2.6 | 0.06 |
| **Stagnation 6h** | | | | |
| Without disinfectant | n.d. | n.d. | 2.6 | 0.06 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | 2.6 | 0.06 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | 2.9 | 0.07 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | 2.9 | 0.07 |
| **Stagnation 24h** | | | | |
| Without disinfectant | n.d. | n.d. | 2.6 | 0.06 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | 2.6 | 0.06 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | 2.7 | 0.06 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | 2.6 | 0.06 |

n.d., not detected

* detection limit for each THM is 0.05 µg/l

*PE-HD – AOX*

| Extraction no. | CRECEP 3rd µg/l | µg/dm²/d | Kiwa 3rd µg/l | ISS 3rd µg/l | µg/dm²/d |
|---|---|---|---|---|---|
| Blank | 10 | | <2 | 10 | 0.23 |
| **Stagnation 6h** | | | | | |
| Without disinfectant | 12 | 0.2778 | <2 | 11 | 0.25 |
| 10 mg/l $Cl_2$ | 25 | 0.5787 | <2 | 13 | 0.29 |
| 50 mg/l $Cl_2$ | 14 | 0.3241 | <2 | 19 | 0.43 |
| 300 mg/l $H_2O_2$ | 16 | 0.3704 | <2 | 18 | 0.41 |
| **Stagnation 24h** | | | | | |
| Without disinfectant | <10 | - | <2 | 18 | 0.41 |
| 10 mg/l $Cl_2$ | 11 | 0.2546 | <2 | 11 | 0.25 |
| 50 mg/l $Cl_2$ | 36 | 0.8333 | <2 | 11 | 0.25 |
| 300 mg/l $H_2O_2$ | < 0 | - | <2 | 16 | 0.36 |

*PE-HD – GCMS*
3rd migration

| Compound (µg/l) | Blank | Stagnation 6h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | Stagnation 24h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
|---|---|---|---|---|---|---|---|---|---|
| *CRECEP* | | | | | | | | | |
| Diterthiobutyl phenol | - | 2.3 | 2.1 | 2.7 | 1.7 | 2.1 | 2.0 | 1.8 | 2.2 |
| 7,9-Ditertiobutyl-1-oxaspiro(4,5deca-6,9-diène-2,8-dione) | - | 0.6 | 0.5 | 0.5 | 0.3 | 0.4 | 0.6 | 0.4 | 0.4 |
| 3-(3,5-ditertiobutyl-4-hydroxyphenyl)propionate de methyle | - | 0.9 | 0.8 | 1.0 | 0.6 | 0.8 | 0.8 | 0.7 | 0.8 |
| *Kiwa* | | | | | | | | | |
| fenol, 2,4-di-ter-butyl- | <0.05 | 1.7 | 1.8 | 1.5 | 1.8 | 1.7 | 1.3 | 1.3 | 1.4 |
| fenol, 2,5-di-tert-butyl-4-methyl-, ionol CP | <0.05 | | 0.1 | 0.1 | | 0.2 | | 0.1 | 0.1 |
| butyl isobutylphtalate | <0.05 | | | | | 0.2 | | | |
| dibutylphtalate | <0.05 | | | | | 1.9 | | | |
| C16-alcohol | <0.05 | | | | | 0.2 | | | |
| cyclohexanon | <0.05 | 8.3 | | 10.8 | 9.8 | | | | |
| hexadecane | <0.05 | | | 0.8 | | | | | |
| eicosane | <0.05 | | | 2.3 | | | | | |
| docosane | <0.05 | 0.5 | | | 0.3 | | | | |
| isoalkane (C21) | <0.05 | | | | | | 0.4 | | |
| Tetracosane | <0.05 | 0.4 | | | | 0.4 | | | |
| Compound with aliphatic structure | <0.05 | 0.1 | | | | 0.1 | | | |
| Compound with aliphatic structure | <0.05 | 1.1 | 0.5 | 0.7 | 0.5 | | 0.4 | 0.2 | |
| Compound with aromatic structure | <0.05 | | | | | | | 0.8 | 0.7 |
| Unknown compound | <0.05 | 0.8 | 0.5 | 0.6 | 0.8 | | | | |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| *ISS* | | | | | | | | | |
| Hydrocarbon (43,71,57,85) | 0.0 | 10.7 | 4.4 | 0.0 | 0.6 | 5.9 | 4.4 | 10.3 | 0.8 |
| Unknown (83,54,82,119) | 0.0 | 5.4 | 1.8 | 2.8 | 1.2 | 4.0 | 2.2 | 4.8 | 0.8 |
| Phthalate (149,177,150,93) | 0.0 | 7.5 | 6.7 | 10.3 | 1.4 | 6.9 | 6.4 | 11.4 | 3.1 |
| Aromatic compound (91,119,43,105) | 0.0 | 5.3 | 1.8 | 8.4 | 0.0 | 2.9 | 3.1 | 5.8 | 0.0 |
| Alkylbenzenesulfonamide (77,141,170,178) | 0.0 | 6.4 | 4.3 | 9.6 | 11.4 | 3.4 | 8.2 | 9.9 | 6.3 |
| Unknown (95,71,57,118) | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 1.2 | 0.9 | 1.6 | 0.0 |

## ANNEX – EPDM RUBBER

*EPDM rubber – odour*

| | TWUL | | | TZW | | | ISS | | |
|---|---|---|---|---|---|---|---|---|---|
| Extraction no. | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| Blank (Evian) | | | | | | | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 4 Ru | 3 Ru | 3 Ru | 8-16 Ro,$H_2S$ | 4-8 Ro,$H_2S$ | 16 Ro,$H_2S$ | 25 Ro | 20 Ro | 25 Ro |
| 10 mg/l $Cl_2$ | 4 Ru | 4 Ru | 7 Ru | 8-16 Ro,$H_2S$ | 8-16 Ro,$H_2S$ | 8-16 Ro,$H_2S$ | 25 Ro | 32 Ro | 32 Ro |
| 50 mg/l $Cl_2$ | 6 Ru | 3 Ru | 5 Ru | 8-16 Ro,Ru | 8 Ro,Ru | 8-16 Ro,Ru | 32 Ro | 25 Ro | 32 Ro |
| 300 mg/l $H_2O_2$ | 6 Ru | 3 Ru | 4 Ru | 8-16 Ro,$H_2S$ | 8 Ro,$H_2S$ | 16 Ro,$H_2S$ | 25 Ro | 20 Ro | 32 Ro |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 5 Ru | 4 Ru | 5 Ru | 8-16 Ro,$H_2S$ | 8 Ro,$H_2S$ | 8-16 Ro,$H_2S$ | 25 Ro | 25 Ro | 25 Ro |
| 10 mg/l $Cl_2$ | 6 Ru | 3 Ru | 5 Ru | 8 Ro,$H_2S$ | 16 Ro,$H_2S$ | 16 Ro,$H_2S$ | 25 Ro | 32 Ro | 32 Ro |
| 50 mg/l $Cl_2$ | 5 Ru | 4 Ru | 7 Ru | 8-16 Ro,Ru | 8 Ro,Ru | 8-16 Ro,Ru | 32 Ro | 25 Ro | 32 Ro |
| 300 mg/l $H_2O_2$ | 5 Ru | 4 Ru | 5 Ru | 16 Ro,$H_2S$ | 8 Ro | 8-16 Ro | 25 Ro | 16 Ro | 25 Ro |

Ro, rotten; Ru, rubber

*EPDM rubber – flavour*

| Extraction no. | TWUL 1st | TWUL 2nd | TWUL 3rd | TZW * 1st | TZW * 2nd | TZW * 3rd | ISS 1st | ISS 2nd | ISS 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | | | | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 4 Ru | 9 Ru | 7 Ru | | | | 4 Ro | 8 Ro | 2 Ro |
| 10 mg/l $Cl_2$ | 6 Ru | 11 Ru | 7 Ru | | | | 4 Ro | 5 Ro | 5 Ro |
| 50 mg/l $Cl_2$ | 8 Ru | 9 Ru | 4 Ru | | | | 5 Ro | 6 Ro | 3 Ro |
| 300 mg/l $H_2O_2$ | 8 Ru | 11 Ru | 4 Ru | | | | 5 Ro | 5 Ro | 2 Ro |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 8 Ru | 9 Ru | 7 Ru | | | | 8 Ro | 8 Ro | 4 Ro |
| 10 mg/l $Cl_2$ | 6 Ru | 11 Ru | 6 Ru | | | | 8 Ro | 5 Ro | 2 Ro |
| 50 mg/l $Cl_2$ | 9 Ru | 9 Ru | 7 Ru | | | | 5 Ro | 5 Ro | 4 Ro |
| 300 mg/l $H_2O_2$ | 6 Ru | 11 Ru | 8 Ru | | | | 4 Ro | 4 Ro | 2 Ro |

Ro, rotten; Ru, rubber

* TFN was not determined by TZW because of the high TON numbers

*EPDM rubber – TOC*

| Extraction no. | TWUL 1st mg/l | TWUL 2nd mg/l | TWUL 3rd mg/l | TZW 1st mg/l | TZW 2nd mg/l | TZW 3rd mg/l | ISS 1st mg/l | ISS 2nd mg/l | ISS 3rd mg/l |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | | | | <0.1 | <0.1 | <0.1 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | 3.4 | 2.4 | 2.1 | 2.7 | 2.4 | 2.3 | 2.6 | 2.1 | 2.3 |
| 10 mg/l $Cl_2$ | 3.3 | 2.4 | 2.1 | 2.1 | 2.0 | 2.3 | 3.4 | 2.7 | 2.2 |
| 50 mg/l $Cl_2$ | 3.9 | 2.5 | 2.2 | 2.6 | 2.5 | 2.3 | 3.7 | 2.5 | 1.9 |
| 300 mg/l $H_2O_2$ | 3.3 | 2.5 | 2.2 | 2.4 | 2.0 | 2.1 | 3.4 | 2.6 | 2.2 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 3 | 2.3 | 2.0 | 2.2 | 2.3 | 2.1 | 3.3 | 2.4 | 2.1 |
| 10 mg/l $Cl_2$ | 2.9 | 2.2 | 2.0 | 2.4 | 2.0 | 2.0 | 2.5 | 2.4 | 2.0 |
| 50 mg/l $Cl_2$ | 4 | 2.4 | 2 | 2.6 | 2.2 | 2.4 | 3.9 | 2.5 | 2.3 |
| 300 mg/l $H_2O_2$ | 3 | 2.1 | 2 | 2.4 | 1.9 | 2.0 | 3.3 | 2.4 | 2.2 |

EPDM rubber – TOC

| Extraction no. | TWUL 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | TZW 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | ISS 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | | | | < 0,01 | < 0,01 | < 0,01 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | 0.2 | 0.2 | 0.1 | 0.20 | 0.17 | 0.17 | 0.17 | 0.14 | 0.15 |
| 10 mg/l $Cl_2$ | 0.2 | 0.2 | 0.1 | 0.15 | 0.15 | 0.17 | 0.23 | 0.18 | 0.15 |
| 50 mg/l $Cl_2$ | 0.3 | 0.2 | 0.2 | 0.19 | 0.18 | 0.17 | 0.25 | 0.17 | 0.13 |
| 300 mg/l $H_2O_2$ | 0.2 | 0.2 | 0.2 | 0.18 | 0.15 | 0.15 | 0.23 | 0.17 | 0.15 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 0.2 | 0.2 | 0.1 | 0.16 | 0.17 | 0.15 | 0.22 | 0.16 | 0.14 |
| 10 mg/l $Cl_2$ | 0.2 | 0.2 | 0.1 | 0.18 | 0.15 | 0.15 | 0.17 | 0.16 | 0.13 |
| 50 mg/l $Cl_2$ | 0.3 | 0.2 | 0.1 | 0.19 | 0.16 | 0.18 | 0.26 | 0.17 | 0.15 |
| 300 mg/l $H_2O_2$ | 0.2 | 0.1 | 0.1 | 0.18 | 0.14 | 0.15 | 0.22 | 0.16 | 0.15 |

*EPDM rubber – THM*

| Extraction no. | TWUL 3rd µg/l | TZW 3rd µg/l | ISS 3rd µg/l |
|---|---|---|---|
| Blank | | | <0.5 |
| **Stagnation 6h** | | | |
| Without disinfectant | n.d. | n.d. | <0.5 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | <0.5 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | <0.5 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | <0.5 |
| **Stagnation 24h** | | | |
| Without disinfectant | n.d. | n.d. | <0.5 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | <0.5 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | <0.5 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | <0.5 |

n.d., not detected

*EPDM rubber – AOX*

| Extraction no. | TWUL 3rd µg/l | TZW 3rd µg/l | ISS 3rd µg/l | µg/dm²/d |
|---|---|---|---|---|
| Blank | | | < 2 | < 0,1 |
| **Stagnation 6h** | | | | |
| Without disinfectant | <10 | < 5 | 11 | 7 |
| 10 mg/l $Cl_2$ | <10 | < 5 | 26 | 1.7 |
| 50 mg/l $Cl_2$ | <10 | < 5 | 16 | 1.1 |
| 300 mg/l $H_2O_2$ | <10 | < 5 | 12 | 0.8 |
| **Stagnation 24h** | | | | |
| Without disinfectant | <10 | < 5 | 19 | 1.3 |
| 10 mg/l $Cl_2$ | <10 | < 5 | 35 | 2.3 |
| 50 mg/l $Cl_2$ | <10 | < 5 | 11 | 0.7 |
| 300 mg/l $H_2O_2$ | <10 | < 5 | 11 | 0.7 |

*EPDM rubber – GCMS*
3rd migration

| Compound (µg/l) | Blank | Stagnation 6h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | Stagnation 24h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
|---|---|---|---|---|---|---|---|---|---|
| *Common* | | | | | | | | | |
| Benzathiazole (TWUL) Benzothiazole (TZW) * | <1 | 12.6 | 27 | 18.2 | 19.4 | 11.7 | 16.5 | 20.1 | 39.4 |
| mercaptobenzothiazole (TWUL) mercaptobenzothiazole (TZW) * | <1 | 450 | 350 | 520 | 260 | 240 | 450 | 390 | 820 |
| (E)-1-propanylbenzyl hydryl sulphide (TWUL) 1-propanylbenzhydryl sulphide (TZW) * | <1 | 28.1 | 19.2 | 29.6 | 13.4 | 13.7 | 24.3 | 20.8 | 36.3 |
| *TWUL* | | | | | | | | | |
| 2-benzothiazolamine-N-ethyl | <1 | 11.2 | 8.6 | 9.4 | 6.2 | 4.8 | 11.1 | 9.5 | 14.6 |
| unknown | <1 | 5.6 | 7 | 7.9 | 4.9 | 5 | 7.1 | 5.6 | 6.4 |
| unknown | <1 | 280 | 260 | 220 | 110 | 140 | 51 | 44 | 62 |
| *ISS* | | | | | | | | | |
| trichloro-1-propene | 0.1 | 0.2 | 0.1 | 0.1 | <0.1 | 0.2 | 0.2 | 0.1 | 0.1 |
| isothiocyanato-ethane | <0.1 | 0.8 | 0.1 | 0.2 | <0.1 | <0.1 | 0.2 | 0.1 | 0.1 |
| N,N-dimethyl formamide | <0.1 | 0.5 | <0.1 | 0.2 | <0.1 | <0.1 | 0.1 | 0.2 | <0.1 |
| trichloro-1-propene | 0.5 | 0.7 | 0.4 | 0.5 | 0.1 | 2.3 | 0.6 | 0.3 | 0.4 |
| pyran,furan compound (85,44,43,67) | <0.1 | 0.1 | 0.1 | 0.1 | <0.1 | 0.3 | 0.1 | 0.1 | 0.3 |
| styrene / 1-3-5-7-cyclooctatetraene (104,78,103,77) | <0.1 | 0.6 | 0.2 | 0.2 | <0.1 | 1.0 | 1.8 | 0.1 | 0.9 |
| 5-ethylidene-bicyclo[2.2.1]hept-2-ene | <0.1 | 0.5 | 0.2 | 0.2 | 0.1 | 0.9 | 0.2 | 0.2 | 0.1 |
| 1,1,2,2-tetrachloroethane | 0.2 | 3.6 | 1.5 | 1.3 | 0.3 | 7.3 | 1.9 | 0.8 | 0.7 |
| unknown (57,28,41,82) | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.8 | 0.1 | 0.1 | <0.1 |
| unknown (82,41,84,71)) | <0.1 | 1.4 | 0.7 | 0.4 | 0.3 | 2.0 | 0.8 | 0.4 | 0.3 |
| 1-butylisothiocyanato | 0.2 | 4.1 | 2.0 | 2.5 | 0.9 | 7.5 | 2.4 | 1.6 | 1.6 |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| unknown (43,72,57,41) | 0.1 | <0.1 | <0.1 | 0.1 | <0.1 | 0.4 | 0.1 | 0.1 | <0.1 |
| branched-chain alkane (43,71,57,41) | 0.3 | 0.4 | <0.1 | 0.2 | 0.1 | 1.2 | 0.2 | 0.1 | 0.3 |
| unknown (58,42,105,70) | 0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 1-piperidinecarboxaldehide | <0.1 | 8.9 | 3.7 | 3.5 | 2.4 | 12.7 | 4.4 | 2.8 | 5.3 |
| unknown (135,77,51,50) | 0.1 | 0.5 | 0.2 | 0.5 | 0.1 | 0.9 | 0.3 | 0.2 | 0.5 |
| tetramethylthiourea | 0.1 | 4.7 | 1.7 | 1.8 | 0.8 | <0.1 | 2.1 | 1.3 | 1.6 |
| N,N-dibutyl-formamide | 0.4 | 42.4 | 15.2 | 16.7 | 10.8 | 64.5 | 15.2 | 12.9 | 21.3 |
| unknown (84,72,69,156) | <0.1 | 8.1 | 3.0 | 3.6 | 2.2 | 11.5 | 3.2 | 2.3 | 4.6 |
| phthalic anhydride | 1.2 | 3.5 | 0.5 | 1.9 | 0.9 | 6.0 | 0.9 | 2.4 | 2.2 |
| unknown (72,57,165,157) | 0.3 | 5.7 | 2.5 | 3.1 | 1.4 | 9.8 | 3.1 | 2.1 | 3.4 |
| unknown (87,45,72,100) | 0.3 | 7.8 | 3.0 | 3.8 | 2.3 | 12.9 | 2.9 | 2.5 | 5.1 |
| hydrocarbon (71,57,43,85) | 1.2 | 0.2 | 0.2 | 0.4 | 0.2 | 2.0 | 0.5 | 0.2 | 0.3 |
| unknown (163,43,121,117) | <0.1 | 40.6 | 16.0 | 17.8 | 9.6 | 59.1 | 19.3 | 11.7 | 18.9 |
| unknown (163,43,121,164) | 0.3 | 9.5 | 4.1 | 5.1 | 2.1 | 0.6 | 5.3 | 3.2 | 5.7 |
| unknown (143,42,59,84) | <0.1 | 0.5 | 0.2 | 0.2 | 0.1 | 0.7 | 0.2 | 0.1 | 0.2 |
| diethyl phthalate | 4.7 | 1.8 | 0.2 | 12.5 | 0.8 | 3.6 | 1.2 | 1.2 | 2.6 |
| unknown (72,95,101,105) | <0.1 | 1.9 | 0.7 | 1.0 | 0.5 | 3.3 | 0.8 | 0.6 | 1.3 |
| unknown (84,172,88,56) | 1.3 | 24.8 | 9.1 | 12.5 | 7.3 | 32.0 | 9.7 | 7.1 | 14.3 |
| alkylbenzothiazole (181,148,108,180) | 0.7 | 30.6 | 10.2 | 10.6 | 10.2 | 51.2 | 13.8 | 8.5 | 21.2 |
| unknown (105,77,182,51) | 0.2 | 3.0 | 1.2 | 1.3 | 1.0 | 5.7 | 1.5 | 1.1 | 2.3 |
| unknown (136,165,42,116) | 0.2 | 1.2 | 0.6 | 1.1 | 0.5 | 1.2 | 0.4 | 0.6 | 0.8 |
| unknown (88,84,112,128) | <0.1 | 2.0 | 0.7 | 0.9 | 0.6 | 3.4 | 0.9 | 0.6 | 1.5 |
| 1,1'-carbonylbispiperidine | 0.2 | 21.5 | 8.0 | 10.1 | 6.6 | 35.2 | 8.4 | 6.9 | 14.9 |
| unknown (149,178,163,136) | 0.4 | 76.3 | 27.2 | 35.2 | 7.7 | 132.1 | 31.0 | 23.9 | 49.2 |
| benzothiazolone | 0.3 | 36.1 | 13.3 | 18.9 | 11.2 | 5.9 | 14.9 | 13.2 | 24.2 |
| unknown (103,154,70,44) | 0.1 | 13.3 | 5.0 | 6.3 | 4.1 | 21.5 | 5.9 | 4.6 | 8.4 |
| diphenylmethoxy acetic acid | 0.9 | 91.4 | 33.3 | 38.1 | 28.7 | 197.0 | 31.0 | 29.6 | 77.3 |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| piperidine compound (127,84,112,140) | 0.2 | 7.0 | 2.5 | 3.8 | 2.0 | 13.0 | 3.4 | 2.5 | 4.7 |
| 2-hydroxy-3-methyl-2-cyclopenten-1-one | <0.1 | 0.4 | 0.2 | 0.2 | 0.1 | 0.8 | 0.2 | 0.2 | 0.3 |
| unknown (180,108,179,136) | 2.8 | 20.6 | 14.8 | 8.9 | 9.4 | 66.1 | 22.7 | 6.4 | 36.6 |
| unknown (105,183,77,184) | 1.7 | 4.0 | 1.9 | 1.9 | 2.1 | 6.3 | 3.6 | 1.5 | 4.9 |
| unknown (151,105,77,51) | 0.1 | 0.5 | 0.2 | 0.1 | 0.1 | 0.8 | 0.2 | 0.2 | 0.2 |
| unknown (93,91,216,117) | 0.3 | 4.1 | 0.1 | 0.3 | 0.2 | 1.0 | 0.2 | 0.1 | 0.4 |
| unknown (165,239,129,91) | 0.1 | 10.5 | 3.5 | 4.5 | 3.1 | 19.9 | 4.9 | 3.6 | 7.3 |
| unknown (178,166,214,108) | 0.1 | 2.6 | 1.1 | 1.1 | 0.4 | 4.8 | 1.4 | 0.9 | 1.2 |
| unknown (195,181,135,165) | 0.7 | 8.6 | 3.7 | 4.9 | 1.8 | 14.5 | 4.7 | 3.3 | 6.3 |
| unknown (203,161,174,55) | 0.2 | 6.4 | 2.5 | 3.1 | 2.2 | 11.1 | 1.8 | 2.0 | 5.1 |
| unknown (84,212,41,96) | <0.1 | 7.3 | 3.0 | 4.1 | 2.5 | 11.5 | 3.6 | 2.5 | 5.4 |
| unknown (108,167,96,122) | 0.7 | 2284.3 | 907.4 | 998.0 | 802.5 | 3857.1 | 1151.2 | 725.8 | 2175.6 |
| unknown (300,242,108,122) | 0.2 | <0.1 | <0.1 | 20.0 | <0.1 | 296.6 | 37.6 | 40.0 | 118.4 |
| unknown (72,238,108,88) | 0.1 | 27.6 | 11.5 | 13.1 | 9.8 | 56.6 | 16.2 | 10.5 | 32.3 |
| unknown (88,254,73,108) | 3.4 | 4.5 | 3.3 | 4.9 | 3.7 | 4.1 | 2.1 | 3.8 | 8.9 |

* quantification could not be done; peak areas are available

## ANNEX – POLYESTER RESIN

*Polyester resin – odour*

| Extraction no. | TZW 1st | 2nd | 3rd | Kiwa 1st | 2nd | 3rd | LHRSP 1st | 2nd | 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | | | |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1-2 O | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1-2 O | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 C |
| 50 mg/l $Cl_2$ | 1-2 O | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.5 C |
| 300 mg/l $H_2O_2$ | 1-2 O | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

O, organic; C, chemical

*Polyester resin – flavour*

| Extraction no. | TZW 1st | 2nd | 3rd | Kiwa 1st | 2nd | 3rd | LHRSP 1st | 2nd | 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | | | |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1-2 B | 1 | 1 | 1 | 1 | 1 | 3 B | 3 B | 5 B |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 3 B | 5 B | 5 B |
| 50 mg/l $Cl_2$ | 1-2 B | 1 | 1 | 1 | 1 | 1 | 5 B | 3 B | 5 B |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 1 | 1 | 1 | 3 B | 3 B | 5 B<br>1.5 C |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 1 | 1 | 1 | 3 B | 5 B,C | 5 B |
| 10 mg/l $Cl_2$ | 1-2 B | 1 | 1 | 1 | 1 | 1 | 5 B | 3 B | 7 B<br>1.5 C |
| 50 mg/l $Cl_2$ | 1-2 B | 1 | 1 | 1 | 1 | 1 | 5 B | 3 B | 7 B<br>3 C |
| 300 mg/l $H_2O_2$ | 1-2 B | 1 | 1 | 1 | 1 | 1 | 2 B | 3 B | 5 B<br>2 C |

B, bitter; C, chemical

*Polyester resin – TOC*

| Extraction no. | TZW 1st mg/l | TZW 2nd mg/l | TZW 3rd mg/l | Kiwa 1st mg/l | Kiwa 2nd mg/l | Kiwa 3rd mg/l | LHRSP 1st mg/l | LHRSP 2nd mg/l | LHRSP 3rd mg/l |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | <0.2 | <0.2 | <0.2 | 0.20 | 0.10 | <0.10 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | 0.1 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.25 | 0.13 | 0.11 |
| 10 mg/l $Cl_2$ | 0.2 | 0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.15 | 0.13 | 0.10 |
| 50 mg/l $Cl_2$ | 0.1 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.15 | 0.17 | 0.16 |
| 300 mg/l $H_2O_2$ | 0.3 | 0.1 | 0.3 | <0.2 | <0.2 | <0.2 | 0.87 | 0.52 | 0.31 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 0.1 | 0.1 | 0.1 | <0.2 | <0.2 | <0.2 | 0.23 | 0.25 | 0.34 |
| 10 mg/l $Cl_2$ | 0.2 | 0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.15 | 0.18 | 0.21 |
| 50 mg/l $Cl_2$ | 0.2 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.35 | 0.15 | 0.23 |
| 300 mg/l $H_2O_2$ | 0.2 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | 0.72 | 0.41 | 0.29 |

Polyester resin – TOC

| Extraction no. | TZW 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | Kiwa 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | LHRSP 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | <0.007 | <0.007 | <0.007 | 0.04 | 0.02 | <0.02 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | <0.01 | <0.01 | <0.01 | | | | 0.02 | 0.01 | 0.01 |
| 10 mg/l $Cl_2$ | 0.01 | <0.01 | <0.01 | | | | 0.01 | 0.01 | 0.01 |
| 50 mg/l $Cl_2$ | <0.01 | <0.01 | <0.01 | | | | 0.01 | 0.01 | 0.01 |
| 300 mg/l $H_2O_2$ | 0.02 | <0.01 | 0.02 | | | | 0.06 | 0.03 | 0.02 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | <0.01 | <0.01 | <0.01 | | | | 0.02 | 0.02 | 0.02 |
| 10 mg/l $Cl_2$ | 0.01 | <0.01 | <0.01 | | | | 0.01 | 0.01 | 0.01 |
| 50 mg/l $Cl_2$ | 0.01 | <0.01 | <0.01 | | | | 0.02 | 0.01 | 0.02 |
| 300 mg/l $H_2O_2$ | 0.01 | <0.01 | <0.01 | | | | 0.05 | 0.03 | 0.02 |

*Polyester resin – THM*

| Extraction no. | TZW 3rd µg/l | Kiwa 3rd µg/l | LHRSP 3rd µg/l |
|---|---|---|---|
| Blank | | | 0.3 |
| **Stagnation 6h** | | | |
| Without disinfectant | n.d. | <0.1 | 0.3 |
| 10 mg/l $Cl_2$ | n.d. | <0.1 | 0.4 |
| 50 mg/l $Cl_2$ | n.d. | <0.1 | 0.4 |
| 300 mg/l $H_2O_2$ | n.d. | <0.1 | n.d. |
| **Stagnation 24h** | | | |
| Without disinfectant | n.d. | <0.1 | n.d. |
| 10 mg/l $Cl_2$ | n.d. | <0.1 | n.d. |
| 50 mg/l $Cl_2$ | n.d. | <0.1 | n.d. |
| 300 mg/l $H_2O_2$ | n.d. | <0.1 | n.d. |

n.d., not detected

*Polyester resin – AOX*

| Extraction no. | TZW 3rd µg/l | Kiwa 3rd µg/l | LHRSP 3rd µg/l |
|---|---|---|---|
| Blank | | <2 | < 10 |
| **Stagnation 6h** | | | |
| Without disinfectant | < 5 | <2 | < 10 |
| 10 mg/l $Cl_2$ | < 5 | <2 | < 10 |
| 50 mg/l $Cl_2$ | < 5 | <2 | 143 |
| 300 mg/l $H_2O_2$ | < 5 | <2 | < 10 |
| **Stagnation 24h** | | | |
| Without disinfectant | < 5 | <2 | < 10 |
| 10 mg/l $Cl_2$ | < 5 | <2 | < 10 |
| 50 mg/l $Cl_2$ | < 5 | <2 | < 10 |
| 300 mg/l $H_2O_2$ | < 5 | <2 | < 10 |

*Polyester resin – GCMS*
3rd migration

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| *Common* | | | | | | | | | |
| phthalic acid, diisobutylester (Kiwa) | < | 1.9 | 1.7 | 1.9 | 1.9 | 1.9 | 1.7 | 2.4 | 1.7 |
| 1,2 benzenedicarboxylic acid, bis (2 methylpropyl) ester (LHRSP) | 0.4 | 1.8 | 1.4 | 1.4 | | | | | |
| *TZW* | | | | | | | | | |
| aromatic oxyen compound | 0.2 | 0.7 | 6.2 | 1.9 | 2.2 | 0.6 | 3.4 | 2.0 | 1.7 |
| 2,6-Di-tert.butyl-4-methylphenol (BHT) | 0.5 | 2.1 | 7.5 | 1.7 | 8.8 | 14.6 | 6.5 | 37.4 | 5.3 |
| unknown | 2.8 | 7.8 | 29.8 | 4.3 | 34.8 | 20.3 | 38.3 | 37.7 | 27.6 |
| *Kiwa* | | | | | | | | | |
| aliphatic oxygen compound | < | 0.7 | 0.7 | 0.8 | 0.3 | 0.7 | 0.6 | 0.7 | 0.2 |
| 4-hydroxy-4-methyl-2-pental | < | 0.3 | 0.4 | 0.5 | 0.2 | 0.3 | 0.4 | 0.4 | 0.1 |
| ethylbenzene | < | 0.3 | 0.3 | 0.4 | 0.1 | 0.3 | 0.3 | 0.3 | 0.1 |
| xylene (isomer) | < | 0.2 | 0.2 | 0.2 | < | 0.2 | 0.2 | 0.2 | < |
| benzylaldehyde | < | 2 | 1.9 | 2.4 | 0.9 | 2 | 2.1 | 2.6 | 0.6 |
| phenylacetaldehyde | < | 0.2 | 0.3 | 0.3 | 0.1 | 0.2 | 0.3 | 0.3 | 0.1 |
| n-nonanoic acid | < | < | 0.1 | 0.1 | < | < | < | 0.1 | < |
| phthalic anhydride or phthalic acid | < | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.4 | 0.1 |
| aromatic oxygen compound | < | 0.4 | 0.4 | 0.6 | 0.3 | 0.4 | 0.5 | 0.5 | 0.2 |
| aromatic oxygen compound | < | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.3 | 0.2 |
| aromatic oxygen compound | < | 1.8 | 1.6 | 1.8 | 2.7 | 1.8 | 1.9 | 3.1 | 1.6 |
| aromatic oxygen compound | < | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.4 | 0.2 |
| probably phthalic ester | < | 0.6 | 0.6 | 0.6 | 1.1 | 0.6 | 0.6 | 1.2 | 0.6 |
| probably phthalic ester | < | 0.5 | 0.4 | 0.5 | 0.9 | 0.5 | 0.5 | 1 | 0.5 |
| aromatic oxygen compound | < | 0.6 | 0.5 | 0.6 | 1 | 0.6 | 0.6 | 1.2 | 0.5 |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| *LHRSP* | | | | | | | | | |
| Diethylphtalate | <0.1 | 10.6 | <0.1 | <0.1 | | | | | |

* quantification could not be done; peak areas are available

## ANNEX – EPOXY RESIN

*Epoxy resin – odour*

| Extraction no. | TWUL 1st | 2nd | 3rd | EPAL 1st | 2nd | 3rd | Kiwa 1st | 2nd | 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 2 (B) | 1 | 1 | 3 | 2 | 2 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (B) | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (B) | 1 | 1 | 3 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 3 (B) | 2 (B) | 1 | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 2 (B) | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (B) | 2 (B) | 1 | 3 | 4 | 4 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (B) | 2 (B) | 1 | 3 | 3 | 3 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 3 (B) | 2 (B) | 1 | 3 | 1 | 1 |

B, burnt

*Epoxy resin – flavour*

| Extraction no. | TWUL 1st | TWUL 2nd | TWUL 3rd | EPAL 1st | EPAL 2nd | EPAL 3rd | Kiwa 1st | Kiwa 2nd | Kiwa 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 2 (A) | 2 (A) | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (A) | 2 (A) | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (A) | 2 (A) | 2 (A,B) | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 2 (A) | 2 (A) | 2 (A,B) | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 1 | 1 | 1 | 2 (A) | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 1 | 1 | 1 | 2 (A) | 2 (A) | 2 (A,B) | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 1 | 1 | 1 | 3 (A) | 2 (A) | 2 (A,B) | 3 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 1 | 1 | 1 | 3 (A) | 2 (A) | 2 (A,B) | 1 | 1 | 1 |

n.d., not detected; A, astringent; B, bitter

*Epoxy resin – TOC*

| Extraction no. | TWUL 1st mg/l | TWUL 2nd mg/l | TWUL 3rd mg/l | EPAL 1st mg/l | EPAL 2nd mg/l | EPAL 3rd mg/l | Kiwa 1st mg/l | Kiwa 2nd mg/l | Kiwa 3rd mg/l |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | <0.4 | <0.4 | <0.4 | <0.2 | <0.2 | <0.2 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | | | | 35 | 31 | 32 | 40 | 11 | 7.5 |
| 10 mg/l $Cl_2$ | 19.9 | 19.7 | 28.6 | 43 | 39 | 36 | 39 | 9.4 | 7.2 |
| 50 mg/l $Cl_2$ | 21.5 | 22.9 | 30.2 | 50 | 42 | 36 | 38 | 10 | 7.4 |
| 300 mg/l $H_2O_2$ | 22.9 | 22.5 | 31.6 | 37 | 33 | 31 | 41 | 7.5 | 7.5 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 21.2 | 20.7 | 28.2 | 42 | 38 | 29 | 40.0 | 11 | 7.5 |
| 10 mg/l $Cl_2$ | 22.8 | 25.9 | 32.1 | 37 | 36 | 31 | 43.0 | 11 | 9.1 |
| 50 mg/l $Cl_2$ | 22.3 | 21.8 | 31.8 | 25 | 30 | 26 | 42 | 11 | 9 |
| 300 mg/l $H_2O_2$ | 23.3 | 22.3 | 31.6 | 33 | 30 | 25 | 45 | 9.6 | 8.5 |

Epoxy resin – TOC

| Extraction no. | TWUL 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | EPAL 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | Kiwa 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d |
|---|---|---|---|---|---|---|---|---|---|
| Blank | | | | | | | | | |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | | | | 2.04 | 1.81 | 1.87 | 1.3 | 0.36 | 0.29 |
| 10 mg/l $Cl_2$ | 1.3 | 1.3 | 1.9 | 2.52 | 2.28 | 2.10 | 1.27 | 0.31 | 0.27 |
| 50 mg/l $Cl_2$ | 1.4 | 1.5 | 2 | 2.93 | 2.44 | 2.10 | 1.24 | 0.33 | 0.28 |
| 300 mg/l $H_2O_2$ | 1.5 | 1.5 | 2.1 | 2.16 | 1.88 | 1.81 | 1.33 | 0.24 | 0.29 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 1.4 | 1.4 | 1.9 | 2.46 | 2.22 | 1.69 | 1.3 | 0.36 | 0.29 |
| 10 mg/l $Cl_2$ | 1.5 | 1.7 | 2.1 | 2.16 | 2.10 | 1.81 | 1.4 | 0.36 | 0.3 |
| 50 mg/l $Cl_2$ | 1.5 | 1.5 | 2.1 | 1.45 | 1.74 | 1.51 | 1.37 | 0.36 | 0.29 |
| 300 mg/l $H_2O_2$ | 1.6 | 1.5 | 2.1 | 1.92 | 1.71 | 1.45 | 1.46 | 0.31 | 0.28 |

*Epoxy resin – THM*

| Extraction no. | TWUL 3rd µg/l | EPAL 3rd µg/l | Kiwa 3rd µg/l |
|---|---|---|---|
| Blank | | 4 | 0.5 |
| **Stagnation 6h** | | | |
| Without disinfectant | n.d. | n.d. | 2.9 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | 2.9 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | 3.1 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | 2.6 |
| **Stagnation 24h** | | | |
| Without disinfectant | n.d. | n.d. | 2.9 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | 2.9 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | 3 |
| 300 mg/l $H_2O_2$ | n.d. | n.d. | 3 |

n.d., not detected

*Epoxy resin – AOX*

| Extraction no. | TWUL 3rd µg/l | EPAL 3rd µg/l | Kiwa 3rd µg/l |
|---|---|---|---|
| Blank | | <9 | <2 |
| **Stagnation 6h** | | | |
| Without disinfectant | <10 | <9 | <2 |
| 10 mg/l $Cl_2$ | <10 | 12 | 2 |
| 50 mg/l $Cl_2$ | <10 | <9 | <2 |
| 300 mg/l $H_2O_2$ | <10 | <9 | 3 |
| **Stagnation 24h** | | | |
| Without disinfectant | <10 | - | <2 |
| 10 mg/l $Cl_2$ | <10 | - | 2 |
| 50 mg/l $Cl_2$ | <10 | - | <2 |
| 300 mg/l $H_2O_2$ | <10 | - | 2 |

*Epoxy resin – GCMS*
3rd migration

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| *Common* | | | | | | | | | |
| ethyl benzene (TWUL) | <1 | - | 1.7 | 5.9 | 4.9 | 2 | 5.1 | 5.5 | 7.3 |
| Ethylbenzene (EPAL) | n.d. | | | | 0.25 | | | 0.65 | 1.16 |
| Ethylbenzene (Kiwa) | n.d. | 2.8 | 2.3 | 2.4 | 1.9 | 2.8 | 2.7 | 2.7 | 3.3 |
| Benzaldehyde (TWUL) | <1 | - | 232 | 136 | 187 | 96 | 278 | 205 | 207 |
| Benzaldehyde (EPAL) | n.d. | 5.69 | 3.12 | 4.6 | 3.18 | 4.34 | 4.26 | 1.5 | 4.01 |
| Benzylaldehyde (Kiwa) | n.d. | 1050 | 980 | 1010 | 1290 | 1050 | 1170 | 1160 | 1310 |
| benzyl alcohol (TWUL) | <1 | - | 5440 | 7300 | 5100 | 4590 | 7050 | 6170 | 6600 |
| Benzyl alcohol (EPAL) | n.d. | 810 | 852 | 897 | 893 | 1076 | 802 | 870 | 884 |
| Benzylalcohol (Kiwa) | n.d. | 19000 | 17000 | 18000 | 25000 | 19000 | 20000 | 22000 | 26000 |
| *TWUL* | | | | | | | | | |
| xylene isomer | <1 | - | 7.7 | 21.6 | 18.7 | 11.9 | 23.7 | 22.6 | 31.7 |
| xylene isomer | <1 | - | 1.5 | 4.3 | 3.9 | 2.2 | 5.1 | 4.3 | 6 |
| caprolactam | <1 | - | 44.6 | 47.3 | 55.7 | 45.7 | 34.1 | 43.5 | 42 |
| unknown | <1 | - | 2.9 | 3.2 | 2.8 | 2.7 | 1.2 | 3 | 2.5 |
| unknown | <1 | - | 4.1 | 4.4 | 4.8 | 5 | 3.8 | 4.6 | 4.5 |
| *EPAL* | | | | | | | | | |
| Benzene, 1,3-dimethyl- | n.d. | | 0.32 | | 1.43 | 0.27 | 0.49 | 2.66 | 4.72 |
| Benzene, 1,4-dimethyl- | n.d. | | | | 0.36 | | 0.14 | 0.56 | 0.88 |
| 2-Cyclohexen-one, 3,5,5-trimethyl- | n.d. | | | | | | | 0.22 | |
| Compound 5 (78, 106, 146, 51) | n.d. | | 0.14 | | 0.15 | | | | |
| Compound 1 (55, 83, 109, 125) | n.d. | | 0.51 | 0.63 | | | 0.76 | 1.52 | |
| Compound 2 (83, 56, 55, 82) | n.d. | | | | | | | 0.18 | |
| Phenol, 2,4,6-trichloro- | n.d. | | 0.18 | 0.20 | | | 1.06 | 1.4 | |
| Phenol, 2,4-di-tert-butyl- | n.d. | | | | | | | 0.14 | |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| Benzyl ether | n.d. | | 0.19 | | 0.15 | 0.18 | | 0.15 | |
| Phthalic acid, diisobutyl ester | n.d. | 0.44 | 0.61 | 0.41 | 1.15 | 0.60 | 0.45 | 0.36 | 0.96 |
| Dibutyl phthalate | n.d. | 0.34 | 0.38 | 0.31 | 0.67 | 0.40 | 0.28 | 0.32 | 0.48 |
| Compound 3 (57, 147, 191, 91) | n.d. | 0.82 | 0.60 | 0.69 | 0.68 | 0.85 | 0.54 | 0.53 | 0.49 |
| Compound 4 (57, 55, 219, 69) | n.d. | 0.14 | 0.14 | 0.15 | 0.16 | 0.19 | 0.17 | 0.15 | 0.16 |
| *Kiwa* | | | | | | | | | |
| ortho-xylene | n.d. | 5.3 | 4.3 | 4.2 | 3.4 | 5.3 | 5 | 5 | 6 |
| meta-para-xylene | n.d. | 2.6 | 2.1 | 2.2 | 1.9 | 2.6 | 2.5 | 2.5 | 3.1 |
| benzylchloride | n.d. | 0.29 | 0.26 | 0.31 | 0.41 | 0.29 | 1.65 | 0.37 | 0.36 |
| an aromatic alcohol | n.d. | 0.62 | 0.57 | 0.6 | 0.63 | 0.62 | 0.53 | 0.54 | 0.73 |
| 2-ethylhexanoic acid | 0.13 | 0.23 | 0.19 | 0.14 | 0.22 | 0.23 | 0.17 | 0.18 | 0.14 |
| aromatic compound | n.d. | 0.39 | 0.33 | 0.36 | 0.34 | 0.39 | 0.39 | 0.42 | 0.47 |
| acetic acid benzylester | n.d. | 0.68 | 0.61 | 0.66 | 0.64 | 0.68 | 0.64 | 0.66 | 0.84 |
| n-nonanoic acid | n.d. | 0.25 | 0.23 | 0.22 | < | 0.25 | 0.18 | 0.16 | < |
| aromatic compound | n.d. | 1.7 | 1.8 | 1 | 1.4 | 1.7 | 2.7 | 2.7 | 2.8 |
| alifatic compoumd | n.d. | 0.48 | 0.61 | 0.63 | 0.56 | 0.48 | 0.67 | 0.85 | 0.07 |
| trichlorophenol | n.d. | 0.12 | 0.09 | 0.18 | 0.11 | 0.12 | 0.2 | 0.27 | 0.15 |
| aromatic compound | n.d. | 1.2 | 1.4 | 0.56 | 1.2 | 1.2 | 1.9 | 1.8 | 2 |
| tributylphosphate | n.d. | < | < | < | < | < | < | < | 0.18 |
| aromatic oxygen compound | n.d. | 1.1 | 0.7 | 0.83 | 1.1 | 1.1 | 1.3 | 0.74 | 1.2 |
| aromatic oxygen compound | n.d. | 1.6 | 1.8 | 1 | 1.5 | 1.6 | 2.3 | 1.9 | 2 |
| bis(benzyloxy)-methaan | n.d. | 0.44 | 0.41 | 0.41 | 0.41 | 0.44 | 0.43 | 0.44 | 0.5 |
| aromatic compound | n.d. | 0.17 | 0.22 | < | 0.15 | 0.17 | 0.28 | 0.21 | 0.22 |
| aromatic compound | n.d. | 0.19 | 0.11 | 0.1 | < | 0.19 | 0.33 | 0.2 | 0.15 |

n.d., not detected

## ANNEX – CEMENT

*Cement – odour*

| Extraction no. | CRECEP 1st | CRECEP 2nd | CRECEP 3rd | EPAL 1st | EPAL 2nd | EPAL 3rd | ISS 1st | ISS 2nd | ISS 3rd |
|---|---|---|---|---|---|---|---|---|---|
| Blank (Evian) | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | | | | 1 | 1 | 1 | 2.5 S | 1.6 S | 1.0 S |
| 50 mg/l $Cl_2$ | | | | 1 | 1 | 1 | 2.5 S | 1.3 S | 1 S |
| 300 mg/l $H_2O_2$ | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | | | | 1 | 1 | 1 | 1.3 S | 1 S | 1 S |
| 10 mg/l $Cl_2$ | | | | 1 | 1 | 1 | 1.3 S | 1.8 S | 1 S |
| 50 mg/l $Cl_2$ | | | | 1 | 1 | 1 | 1.0 S | 1.3 S | 1.3 S |
| 300 mg/l $H_2O_2$ | | | | 1 | 1 | 1 | 1.3 S | 1 S | 1 S |

S, sweet

*Cement – flavour*

| | CRECEP | | | EPAL | | | ISS | | |
|---|---|---|---|---|---|---|---|---|---|
| Extraction no. | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| Blank (Evian) | 1.5 Str,B | 2 Str | 1.5 Str | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 6h** | | | | | | | | | |
| Without disinfectant | 4 S,Str | 4 Sta,S,Str | 3 S,Str | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 8 S,Str,R | 6 Str,Sta,S,B | 5 S,Sta,Str | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 8 S,Str,R | 7 Str,S,B | 6 S,Str,B | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 4 Sta,S,Str | 4 Str,Sta | 3 Str,B | 1 | 1 | 1 | 1 | 1 | 1 |
| **Stagnation 24h** | | | | | | | | | |
| Without disinfectant | 3 S,Str | 3 Str,B,Sta | 4 S,Str | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 mg/l $Cl_2$ | 6 S,Str,R | 5 Str,S | 5 S,B,Str | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 mg/l $Cl_2$ | 6 S,Str | 5 Str,S | 6 S,Str | 1 | 1 | 1 | 1 | 1 | 1 |
| 300 mg/l $H_2O_2$ | 4 S,Sta,Str | 3 Str,B,Sta | 5 S,Str,Sta,Ra | 1 | 1 | 1 | 1 | 1 | 1 |

B, bitter; R, rotten fruit; Ra, rancid Sta, stagnant; Str, stringent

*Cement – TOC*

| Extraction no. | CRECEP 1st mg/l | CRECEP 2nd mg/l | CRECEP 3rd mg/l | EPAL 1st mg/l | EPAL 2nd mg/l | EPAL 3rd mg/l | ISS 1st mg/l | ISS 2nd mg/l | ISS 3rd mg/l |
|---|---|---|---|---|---|---|---|---|---|
| Blank | <0.2 | <0.2 | <0.2 | <0.4 | 0.4 | <0.4 | <0.1 | <0.1 | <0.1 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | 4.2 | 2.8 | 2.2 | 5.9 | 5.6 | 3.2 | 4.9 | 2.9 | 2.0 |
| 10 mg/l $Cl_2$ | 6.3 | 4.5 | 3.3 | 5.5 | 6 | 2.8 | 2.4 | 0.7 | <0.1 |
| 50 mg/l $Cl_2$ | 4.8 | 2.9 | 2.4 | 6.1 | 2.5 | 2.3 | 2.9 | 1.6 | 1.7 |
| 300 mg/l $H_2O_2$ | 5.2 | 3.1 | 2.7 | 5.1 | 4.2 | 3.8 | 4.5 | 2.1 | 1.4 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 4.8 | 3.5 | 3.0 | 6.4 | 5.2 | 3.1 | 3.4 | 1.4 | 0.6 |
| 10 mg/l $Cl_2$ | 3.6 | 2.5 | 2.0 | 5.5 | 4.9 | 3.2 | 3.7 | 1.3 | 0.7 |
| 50 mg/l $Cl_2$ | 3.9 | 2.6 | 2.3 | 4.6 | 3 | 2.8 | 2.8 | 0.5 | 1.9 |
| 300 mg/l $H_2O_2$ | 3.9 | 2.9 | 2.4 | 4.6 | 2.9 | 2.3 | 3.0 | 1.5 | 1.1 |

Cement – TOC

| Extraction no. | CRECEP 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | EPAL 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d | ISS 1st mg/dm²/d | 2nd mg/dm²/d | 3rd mg/dm²/d |
|---|---|---|---|---|---|---|---|---|---|
| Blank | < 0.01 | < 0.01 | < 0.01 | | | | < 0.01 | < 0.01 | < 0.01 |
| **Stagnation 6h** | | | | | | | | | |
| No disinfectant | 0.25 | 0.17 | 0.13 | 0.430 | 0.406 | 0.219 | 0.29 | 0.17 | 0.12 |
| 10 mg/l $Cl_2$ | 0.38 | 0.27 | 0.20 | 0.398 | 0.438 | 0.188 | 0.14 | 0.04 | < 0.01 |
| 50 mg/l $Cl_2$ | 0.29 | 0.17 | 0.14 | 0.445 | 0.164 | 0.148 | 0.17 | 0.10 | 0.10 |
| 300 mg/l $H_2O_2$ | 0.31 | 0.18 | 0.16 | 0.367 | 0.297 | 0.266 | 0.27 | 0.13 | 0.08 |
| **Stagnation 24h** | | | | | | | | | |
| No disinfectant | 0.29 | 0.21 | 0.18 | 0.469 | 0.375 | 0.211 | 0.20 | 0.08 | 0.04 |
| 10 mg/l $Cl_2$ | 0.21 | 0.15 | 0.12 | 0.398 | 0.352 | 0.219 | 0.22 | 0.08 | 0.04 |
| 50 mg/l $Cl_2$ | 0.23 | 0.15 | 0.14 | 0.328 | 0.203 | 0.188 | 0.17 | 0.03 | 0.11 |
| 300 mg/l $H_2O_2$ | 0.23 | 0.17 | 0.14 | 0.328 | 0.195 | 0.148 | 0.18 | 0.09 | 0.07 |

*Cement – THM*

| Extraction no. | CRECEP 3rd µg/l | EPAL 3rd µg/l | ISS 3rd µg/l |
|---|---|---|---|
| Blank | n.d. | 2 | < 0.5 |
| **Stagnation 6h** | | | |
| Without disinfectant | n.d. | 2 | < 0.5 |
| 10 mg/l $Cl_2$ | n.d. | n.d. | < 0.5 |
| 50 mg/l $Cl_2$ | n.d. | n.d. | < 0.5 |
| 300 mg/l $H_2O_2$ | n.d. | 2 | < 0.5 |
| **Stagnation 24h** | | | |
| Without disinfectant | n.d. | 2 | < 0.5 |
| 10 mg/l $Cl_2$ | n.d. | 2 | < 0.5 |
| 50 mg/l $Cl_2$ | n.d. | 3 | < 0.5 |
| 300 mg/l $H_2O_2$ | n.d. | 2 | < 0.5 |

n.d., not detected

*Cement – AOX*

| Extraction no. | CRECEP 3rd µg/l | EPAL 3rd µg/l | ISS 3rd µg/l |
|---|---|---|---|
| Blank | < 10 | 13 | <2 |
| **Stagnation 6h** | | | |
| Without disinfectant | < 10 | 12 | 11 |
| 10 mg/l $Cl_2$ | < 10 | 9 | 10 |
| 50 mg/l $Cl_2$ | < 10 | < 7 | 6 |
| 300 mg/l $H_2O_2$ | < 10 | 11 | 12 |
| **Stagnation 24h** | | | |
| Without disinfectant | < 10 | < 7 | 9 |
| 10 mg/l $Cl_2$ | < 10 | < 7 | 8 |
| 50 mg/l $Cl_2$ | < 10 | 12 | 10 |
| 300 mg/l $H_2O_2$ | < 10 | < 7 | 7 |

*Cement – GCMS*
3rd migration

| Compound (µg/l) | Blank | Stagnation 6h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | Stagnation 24h No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
|---|---|---|---|---|---|---|---|---|---|
| *EPAL* | | | | | | | | | |
| n-Dodecanol | | 0.51 | 0.52 | 0.60 | | | | | 0.73 |
| Para-methoxy-a-phenylphenethyl Alcohol | | | 0.49 | | | | | | 0.52 |
| Compound 1 (45, 91, 89, 108, 134) | | 0.62 | 0.87 | 0.79 | 0.69 | 0.52 | 0.64 | | 0.89 |
| Compound 4 (45, 108, 91, 89, 133) | | | 0.52 | 0.48 | | | | | 0.53 |
| Dibutyl phthalate | | 0.44 | | | | | 0.64 | 0.94 | 0.59 |
| 2,6-Dimethylphenyl-a-phenylpropionate | | 0.99 | 1.4 | 1.2 | 0.98 | 0.83 | 1.1 | | 1.3 |
| p-allylphenol | | 0.60 | 0.85 | 0.80 | 0.71 | 0.47 | 0.56 | | 0.84 |
| Compound 3 (45, 89, 91, 108, 134) | | | 0.55 | 5.3 | 0.47 | | | | 0.56 |
| Compound 2 (45, 122, 89, 105, 148) | | 0.92 | 1.3 | 1.2 | 0.96 | 0.76 | 0.87 | | 1.3 |
| Compound 5 (45, 122, 89, 105, 133) | | 0.49 | 0.68 | | 0.53 | | | | |
| *ISS* | | | | | | | | | |
| chloroform | 0.1 | 4.5 | 9.2 | 4.9 | 16.9 | 2.4 | 5.1 | 4.1 | 12.3 |
| trimethyloxyrane | 0.3 | 0.8 | 1.4 | 1.0 | 3.7 | 0.6 | 0.9 | 1.1 | 2.9 |
| carbon tetrachloride | 0.1 | 0.3 | 0.4 | 0.3 | 1.3 | 0.2 | 0.4 | 0.4 | 1.2 |
| unknown (43,41,86,28) | < 0.1 | 0.2 | 0.3 | 0.1 | 1.1 | 0.1 | 2.9 | 0.3 | 0.6 |
| trichloroethylene | 1.2 | 1.2 | 1.9 | 1.1 | 5.5 | 0.9 | 18.0 | 1.7 | 3.8 |
| unknown (28,32,36,40) | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 |
| unknown (28,32,36,37) | < 0.1 | 0.1 | 1.0 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | 9.2 |
| trichloro-1-propene | 0.2 | 0.2 | 0.7 | 0.3 | 4.4 | 0.2 | 9.2 | 0.3 | 6.3 |
| hydrocarbon (28,43,81,57) | < 0.1 | < 0.1 | < 0.1 | 0.2 | 2.9 | < 0.1 | < 0.1 | < 0.1 | 0.5 |
| trichloro-1-propene | 0.4 | 1.0 | 0.8 | 0.5 | 1.9 | 0.4 | 0.4 | 0.7 | 1.0 |
| 1,1,2,2-tetrachloroethane | 0.2 | 0.1 | 0.3 | 0.2 | < 0.1 | 0.2 | 0.1 | 0.3 | 0.3 |
| hydrocarbon (57,56,33,123) | 0.1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 | 0.1 | < 0.1 | 0.3 |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| hydrocarbon (43,71,57,85) | 0.9 | 0.3 | 0.7 | 0.6 | 3.1 | 0.4 | 1.1 | 0.3 | 2.1 |
| hydrocarbon (43,71,57,27) | 0.2 | 0.1 | 0.1 | 0.1 | 1.0 | 0.1 | 0.1 | 0.1 | 0.6 |
| hydrocarbon (43,71,57,85) | 0.1 | 0.1 | 0.1 | 0.1 | 0.6 | 0.1 | 0.1 | 0.1 | 0.5 |
| hydrocarbon (43,71,57,41) | 0.3 | 0.3 | 0.3 | 0.3 | 3.1 | 0.3 | 0.3 | 0.2 | 2.1 |
| hydrocarbon (43,71,57,85) | 0.3 | 0.2 | 0.1 | 0.1 | 1.4 | 0.2 | 0.1 | 0.1 | 2.0 |
| hydrocarbon (43,71,57,36) | 0.1 | 0.1 | 0.1 | 0.1 | 1.1 | 0.1 | 0.1 | 0.1 | 0.8 |
| hydrocarbon (43,71,57,85) | 0.4 | 0.3 | 0.4 | 0.4 | 4.1 | 0.4 | 0.3 | 0.3 | 2.9 |
| unknown (84,43,28,95) | 0.1 | < 0.1 | 0.5 | 0.1 | < 0.1 | 0.3 | 0.1 | 0.2 | < 0.1 |
| hydrocarbon (43,57,71,85) | 0.3 | 0.1 | 0.2 | 0.1 | 1.2 | 0.1 | 0.2 | 0.4 | 0.8 |
| hydrocarbon (71,43,57,85) | 0.6 | 1.0 | 0.3 | 1.0 | 3.9 | 0.3 | 1.9 | 0.2 | 1.8 |
| hydrocarbon (71,57,43,85) | 0.2 | 0.2 | 0.2 | 0.2 | 1.5 | 0.2 | 0.2 | 0.1 | 1.1 |
| unknown (71,43,57,85) | 0.4 | 0.3 | 0.4 | 0.3 | 2.3 | 0.3 | 0.4 | 0.2 | 1.6 |
| hydrocarbon (71,43,57,85) | 0.1 | 0.1 | 0.1 | 0.1 | 0.9 | 0.1 | 0.1 | 0.1 | 0.6 |
| unknown (73,60,41,38) | < 0.1 | < 0.1 | 0.1 | < 0.1 | 0.5 | < 0.1 | < 0.1 | 0.1 | < 0.1 |
| N,N-dialkilammine (72,127,70,56) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 1.7 | < 0.1 | < 0.1 | < 0.1 | 0.5 |
| unknown (106,108,156,124) | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0.1 |
| hydrocarbon (71,43,57,85) | 1.2 | 0.8 | 1.0 | 1.0 | < 0.1 | 0.8 | 1.1 | 0.7 | 4.5 |
| unknown (71,43,41,36) | 0.3 | 0.1 | 0.4 | 0.1 | 0.3 | 0.2 | 0.1 | 0.1 | 0.2 |
| hydrocarbon (71,57,43,85) | 0.7 | 0.5 | 0.5 | 0.5 | 2.8 | 0.4 | 0.5 | 0.3 | 2.1 |
| hydrocarbon (71,57,43,85) | 1.3 | 0.7 | 1.2 | 0.9 | 4.5 | 0.9 | 1.0 | 0.6 | 3.1 |
| hydrocarbon (57,71,69,219) | 0.4 | 0.4 | 0.5 | 0.4 | 1.9 | 0.4 | 0.4 | 0.4 | 1.1 |
| alkilbenzene (91,119,105,41) | 0.2 | 0.3 | 0.3 | 0.3 | 0.9 | 0.3 | 0.2 | 0.3 | 0.5 |
| phthalate (149,105,57,104) | 2.8 | 2.3 | 3.6 | 2.6 | 10.8 | 2.7 | 2.4 | 2.8 | 4.2 |
| unknown (77,141,170,36) | 0.2 | 0.5 | 1.0 | 0.7 | 5.2 | 0.4 | 0.8 | 0.6 | 1.8 |
| unknown (205,57,175,41) | 0.7 | 0.6 | 0.8 | 0.1 | 3.8 | 0.6 | 0.8 | 0.5 | 0.4 |
| hydrocarbon (161,57,71,85) | 0.2 | 0.3 | 0.3 | 0.2 | 2.3 | 0.3 | 0.2 | < 0.1 | 1.0 |
| hydrocarbon (57,71,43,85) | < 0.1 | 0.2 | 0.4 | 0.1 | 3.0 | 0.3 | 0.3 | < 0.1 | 0.4 |

| Compound (µg/l) | Blank | Stagnation 6h | | | | Stagnation 24h | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ | No | 10 mg/l $Cl_2$ | 50 mg/l $Cl_2$ | 300 mg/l $H_2O_2$ |
| unknown (56,57,43,41) | 0.7 | 0.6 | 1.0 | 1.1 | 2.5 | 0.6 | 1.0 | 1.2 | < 0.1 |
| unknown (43,57,83,97) | 0.3 | 0.3 | 1.4 | 0.7 | 1.1 | 0.9 | 0.2 | 0.1 | 0.3 |
| hydrocarbon (57,43,71,85) | < 0.1 | 0.2 | 0.9 | 0.1 | 0.2 | 0.6 | 0.1 | < 0.1 | < 0.1 |
| unknown (57,71,43,44) | < 0.1 | 0.1 | < 0.1 | < 0.1 | 0.2 | < 0.1 | < 0.1 | < 0.1 | 0.9 |
| hydrocarbon (71,57,85,315) | 0.2 | 0.2 | 0.2 | < 0.1 | 1.1 | 0.2 | 0.1 | 0.1 | 0.3 |
| hydrocarbon (57,43,71,85) | 0.3 | 0.2 | 1.0 | < 0.1 | 0.7 | 0.9 | 0.1 | < 0.1 | < 0.1 |
| acid octadecanoic esther (56,57,43,41) | 0.2 | 1.0 | 0.7 | 0.8 | 0.9 | 0.5 | 0.3 | 0.7 | 0.5 |
| unknown (161,127,57,71) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.2 |
| unknown (72,69,84,86) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.6 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| unknown (28,85,147,87) | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| unknown (28,32,40,29) | < 0.1 | 1.9 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| phthalate (149,167,57,71) | 0.3 | 0.9 | 0.9 | 0.7 | 6.3 | 0.8 | 1.0 | 0.5 | 2.6 |
| unknown (73,149,126,57) | < 0.1 | 0.2 | 0.2 | 0.2 | 0.6 | 0.2 | 0.1 | 0.1 | < 0.1 |
| unknown (57,71,43,85) | 0.1 | 0.1 | 0.2 | < 0.1 | < 0.1 | 0.4 | < 0.1 | < 0.1 | < 0.1 |
| unknown (96,69,81,36) | < 0.1 | 0.1 | 0.2 | 0.5 | 0.3 | < 0.1 | 0.1 | < 0.1 | < 0.1 |
| *CRECEP – not detected* | | | | | | | | | |

## ANNEX – DETAILED RESULTS PER LABORATORY

See separate report

**Mission of the JRC**

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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