Benetton Group srl

2021 Wastewater Analysis

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Introduction

Textile industry is linked to water pollution due to the large use of chemicals in its production processes. All 'textile wet processing', that include dyeing, washing, printing and fabric finishing, lead to the discharge of large quantities of wastewater containing toxic substances, many of which are hazardous and persistent. With the aim of "cleaning" the whole textile supply chain (i.e., clean factory approach), starting from 2013 Benetton collaborates with Greenpeace through the Detox Campaign[1] towards the complete elimination of hazardous chemicals from manufacturing and it has defined a Detox Programme Guideline, addressed to all its wet process suppliers.
In line with its Detox Commitment, Benetton Group joined two organizations: *Zero Discharge of Hazardous Chemicals* (ZDHC)[2] Group and *Sustainable Apparel Coalition* (SAC)[3], where international brands cooperate to improve the environmental performance of the supply chain and to develop methodologies to minimize and eliminate hazardous chemicals from textile production.
Tools and methodologies of both organization, as for example ZDHC Wastewater Guideline and Higg Facility Environmental Module (Higg FEM), are included in the Benetton's Detox Programme Guideline.

ZDHC Wastewater Guideline was released at the end of 2016 but, even if Benetton started adopting it from 2017, only in the last two years it was possible to collect a significant sample of test results. This was mainly due to the fact that the release and the finalization of the ZDHC Gateway took some time, not only for technical issues but also to allow time for suppliers' awareness of the importance to test following a standardized protocol, as well as sharing their wastewater test results within a shared portal.
In particular, from the ZDHC Gateway – Wastewater Module, it is possible to download all test results in a common excel format and then compare and analyze all reported data.

The ZDHC Wastewater Guidelines define a single, unified standard for wastewater testing that goes beyond regulatory compliance and conventional wastewater testing parameters and results are accepted by all ZDHC brands. According to this document, chemicals to be tested in wastewater are divided into two macro-groups, that are Conventional Parameters and MRSL Parameters. Conventional Parameters have to be tested in discharged wastewater while, concerning the MRSL Parameters, there are two testing options: discharged wastewater and sludge (Option 1) or discharged wastewater and raw wastewater (Option 2). Incoming water is tested only in case of findings, either in the discharged or in the raw wastewater.

In this report, data of wastewater analysis performed by Benetton's suppliers, have been analyzed by considering data disclosed in the ZDHC Gateway – Wastewater Module during the 2021 year, without distinguish among the testing options because, actually, this information is not "managed" in the excel file downloadable from the Gateway.

[1] Benetton's Detox Commitment: http://www.benettongroup.com/sites/all/temp/benetton_group_detox_commitment_1.pdf
[2] http://www.roadmaptozero.com/
[3] https://apparelcoalition.org/

2021 Wastewater Analysis

According to the data collected from the test reports published in the ZDHC Gateway – Wastewater Module during 2021, it emerges that 175 wet process suppliers working with Benetton, and representing more than 80% in terms of volume (pcs produced by year), have performed wastewater analysis according to the ZDHC Wastewater Guideline, by following either option 1 or option 2.
As shown in figure 1, around 60% of these plants are located in Asia (mainly in Bangladesh, China and India) and 40% in the Mediterranean Area (mainly in Italy and Turkey).

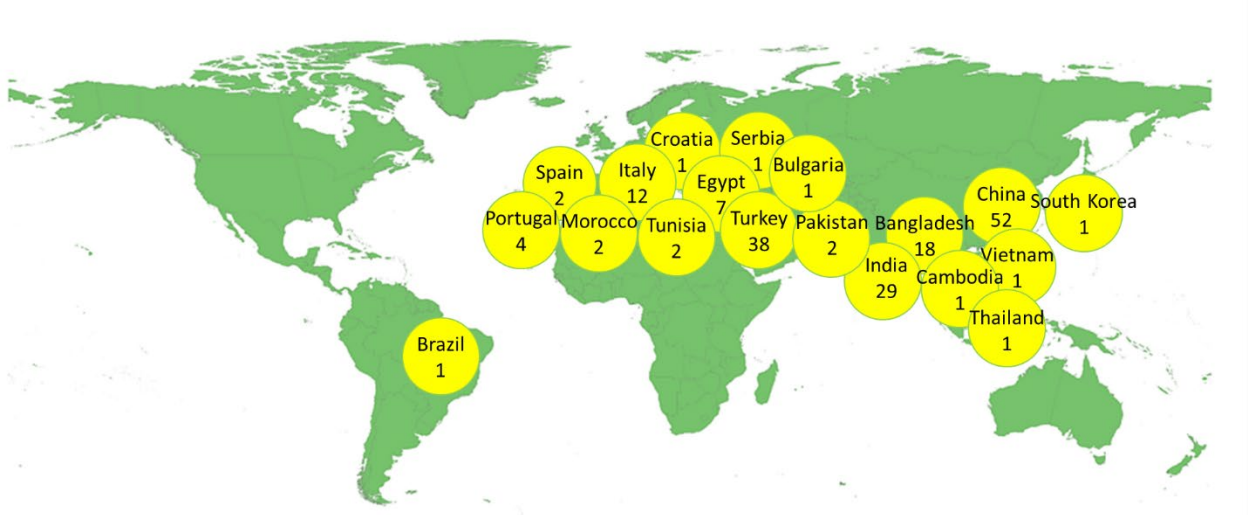

Figure 1 Country distribution

The collected data refer to facilities having different types of Effluent Treatment Plant (ETP) such as direct discharge (i.e. 53 facilities), indirect discharge (i.e. 107 facilities) and zero liquid discharge (i.e. 15 facilities). Some of them made only one test during the current year, some others more than one, and among these, there are also facilities that made one test by following option 1 and one test following option 2 (or vice versa). This implies that is quite difficult, if not impossible, to perform a good analysis since there is not an aligned set of data.
As a whole, it emerges that all facilities are very close to be totally in line with ZDHC requirements, showing an overall compliance (average value) of about 97%. Figure 2 shows the compliance percentage of all substance groups in three sampling points.

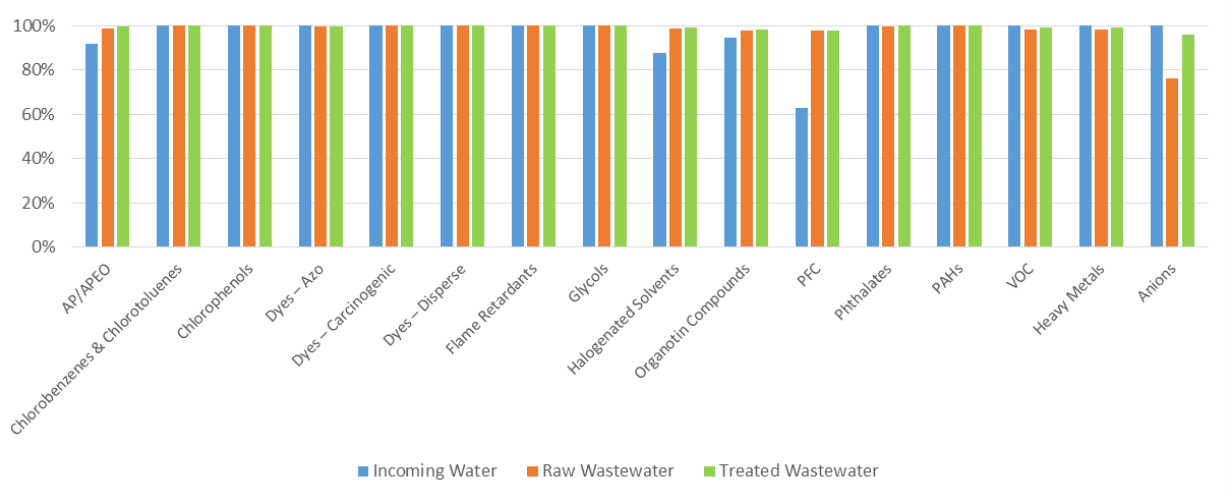

Figure 2 Compliance's Percentage.

It clearly occurs that Incoming Water is often already polluted, meaning that the possibility of finding contaminations in wastewater is very high. In particular, AP/APEOs, Organotin Compounds and Halogenated Solvents and PFCs are the main substance groups we can find in the Incoming Water. All other chemical groups are totally compliance with ZDHC MRSL and there are not any detection in Incoming Water.
It is important to note that in the ZDHC Wastewater Guideline sampling and testing of Incoming Water is not a requirement since it could be part of the root cause analysis when there is non-conformities in the MRSL parameters' tests. This imply that the number of test performed in 2021 in Incoming Water is much lower than those made in the Raw and in the Treated Wastewater because there are still some suppliers asking for sampling and testing Incoming Water at the same time of the other two samples. Therefore, having less test, the percentage of not compliance in Incoming Water is higher than that in the Raw and Treated Wastewater.

To have a better understanding of the chemical substances that is possible to find in discharged water of textile industries, we decided to perform the analysis by considering the classification of the chemical substances groups defined in the ZDHC Wastewater Guideline: MRSL Parameters, Heavy Metals, Anions and Conventional Parameters[4]. The first three groups refer to Incoming, Raw and Treated Wastewater respectively. The last group, instead, refers only to Treated Wastewater of facilities with Direct Discharge.

1. MRSL Parameters

According to ZDHC Wastewater Guideline's classification, MRSL Parameters is constituted by 18 Chemical Groups: AP/APEO, Chlorobenzenes and Chlorotoluenes, Chlorophenols, Dyes – Azo, Dyes – Carcinogenic, Dyes – Disperse, Flame Retardants, Glycols, Halogenated Solvents, Organotin Compounds, PFC, Phthalates, PAHs, VOC. All these groups have been tested either in the Raw or Treated Wastewater and, as root cause analysis, in the Incoming Water according to the methods described in the ZDHC WW Guideline[5].
In total, concerning MRSL parameters, 61094 analytes have been tested and results show that only 217 (less than 0.5%) have been detected (both below and above ZDHC Limits). Therefore, we can conclude that, in general, facilities are very close to the total compliance of MRSL Parameters.

Alkylphenols and Alkylphenols Ethoxylates (AP/APEO)

Alkylphenols and Alkylphenols Ethoxylates (AP/APEO) have been detected both in Raw and in Treated Wastewater but they are already present also in the Incoming water. In particular, results show that AP/APEO have been detected in the Incoming water of a facility located in Italy.
The total number of AP/APEO's analytes tested in the 175 facilities is 1336 with 15 detections (mainly in the Raw Wastewater) and, among those, 13 exceed the ZDHC Limits.
Regarding non-conformities in Treated Wastewater, only an NP's detection has been found in a facility located in Egypt. By looking at the non-conformities in Raw Wastewater, instead, NPEO is the substance mainly detected and it has been found in facilities located in China, Italy and Turkey (figure 3).

[4] We use "Conventional Parameters" to refer to the Sum Parameters defined in the Appendix A of the ZDHC Wastewater Guideline v.1.1. In the ZDHC document, in fact, Conventional Parameters include Sum Parameters, Anions and Heavy Metals.

[5] As already mentioned in the previous paragraph, even if sampling and testing of Incoming Water is not a requirement in the ZDHC Wastewater Guideline, some facilities still do it at the same time of the Raw and Treated Wastewater sampling.

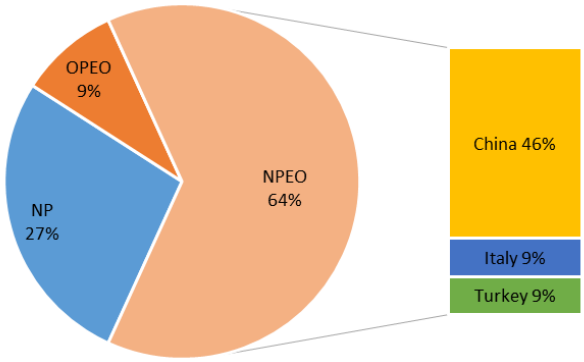

Figure 3 AP/APEO's non-conformities in Raw Wastewater.

Chlorobenzenes and Chlorotoluenes

Chlorobenzenes and Chlorotoluenes have been detected in the Raw and in the Treated Wastewater. In total, 10008 analytes have been tested with a percentage of detection (including non-conformities) of 0.10%. In fact, the number of detections, all above the ZDHC limit, is 10: five have been found in the Raw Wastewater and five in the Treated Wastewater.

Figure 4 represents the non-conformities of Chlorobenzenes and Chlorotoluenes in Raw and Treated Wastewater: it emerges that all detections are below 0.04% and the main substances are Monochlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,3,5-Trichlorobenzene, 2-Chlorotoluene, 3-Chlorotoluene, 4-Chlorotoluene.

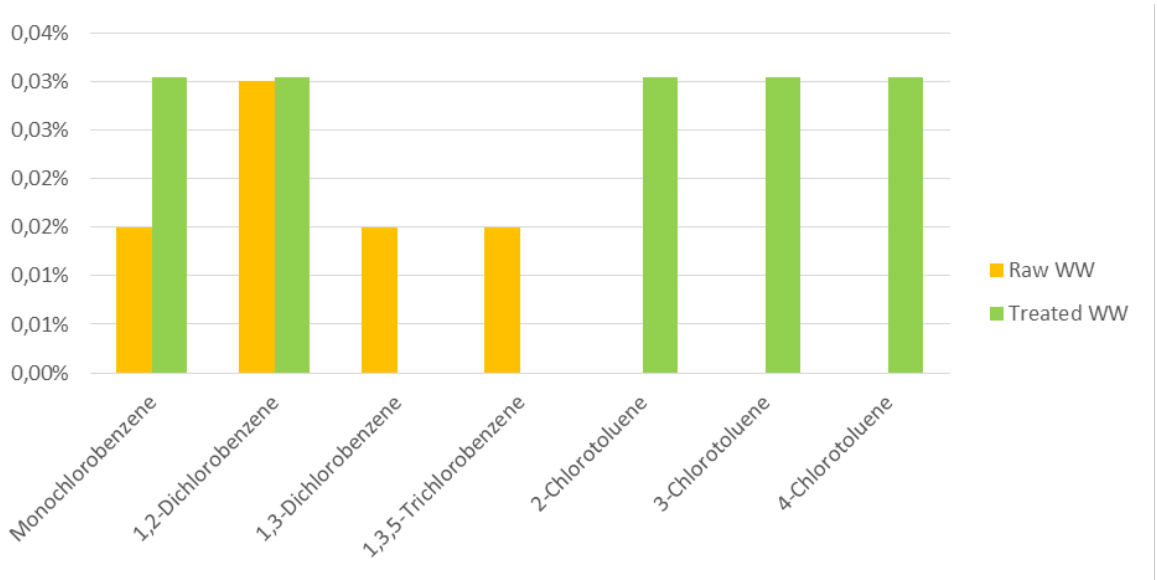

Figure 4 Chlorobenzenes and Chlorotoluenes non-conformities in Raw and Treated Wastewater.

All detections have been found in ten facilities located in China, Tunisia and Turkey.

Chlorophenols

The total number of tested Chlorophenols is 6364 with 7 non-conformities, all above ZDHC limit, detected in Raw Wastewater. Since each analyte exceeding the ZDHC limit represent less than 0.05% non-conformities (Figure 5), these detections are considered impurities.

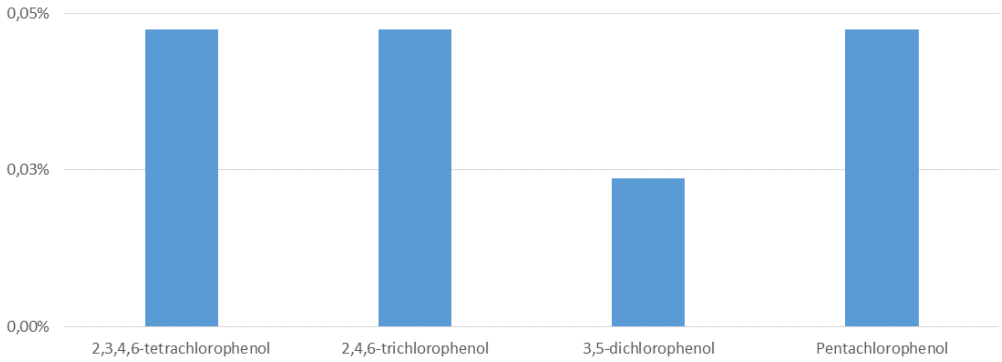

Figure 5 Chlorophenols' non-conformities in Raw Wastewater.

Chlorophenols' detections belong to four facilities located in China and to one located in Bangladesh.

Dyes – Azo

Among 18488 test performed on Colorants, Azo – Dyes (8135 tested analytes) is the only substance group with some detections. From results, in fact, there is no any detection of Dyes – Carcinogenic (4341 tested analytes) and Dyes – Disperse (6012 tested analytes).
Non-conformities of Azo-Dyes represent 0.47% and 0.37% in Raw Wastewater and in Treated wastewater, respectively. Figure 6 shows detections in Raw and Treated wastewater: 4-chloroaniline is the substance with high detection (52% and 50% respectively), followed by 4,4'-methylenedianiline (32% and 20%), o-toluidine (8% and 20%) and traces of 3,'3-dichlorobenzidine and 4-methyl-m-phenylenediamine.

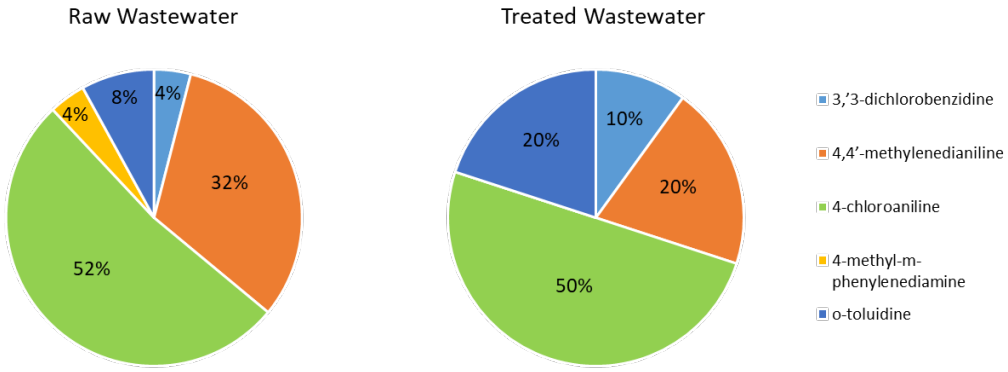

Figure 6 Dyes-Azo main detections in Raw Wastewater.

All detections, both in Raw Wastewater and in Treated Wastewater, have been found in facilities located in China, Italy and Turkey.

Halogenated Solvents

Halogenated Solvents is one of the substances group already present in the Incoming Water, especially in Italy (Methylene chloride and Tetrachloroethylene) and Tunisia (Tetrachloroethylene). In total, 1358 analytes have been tested: 24 in Incoming Water, 886 in Raw Wastewater and 448 in Treated Wastewater. The 20 detections are all above ZDHC limit: 13 in Raw Wastewater, 4 in Treated Wastewater and 3 in Incoming Water. Tetrachloroethylene, Methylene chloride, 1,2-dichloroethane and Trichloroethylene are the four halogenated solvents detected: as shown in figure 7 they are all present in raw wastewater, while Tetrachloroethylene and Methylene chloride have been detected in the Incoming water and in the Treated Wastewater too.

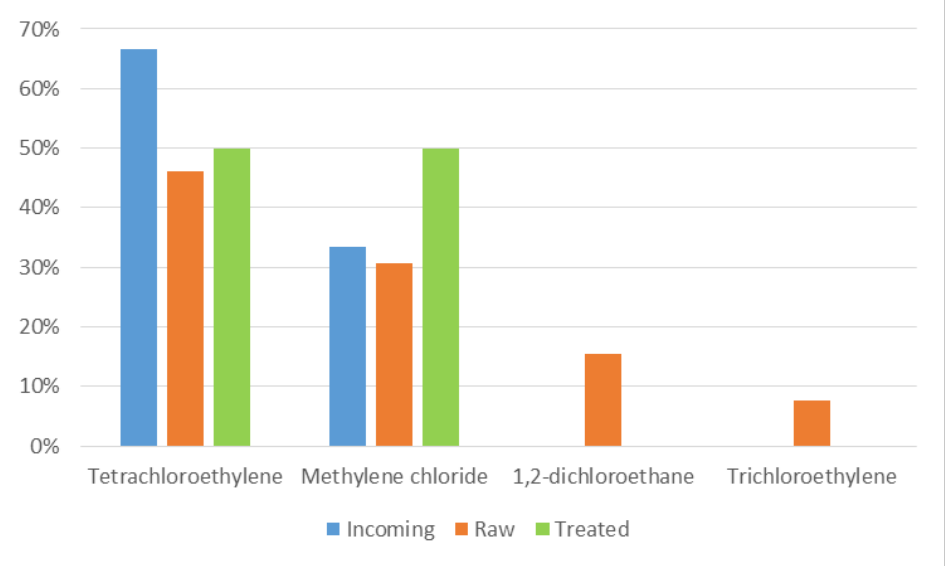

Figure 7 Halogenated Solvents non-conformities.

Regarding detection in Raw Wastewater, it emerges that the biggest pollution is in China and Italy, followed by Croatia, Egypt, Tunisia and Turkey (figure 8).

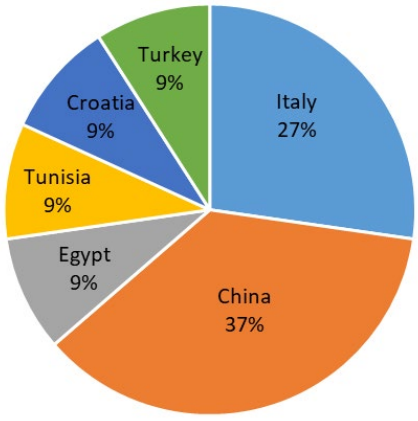

Figure 8 Halogenated Solvents' detection in Raw Wastewater by Country.

Organotin Compounds

Organotin Compounds is one of the substance groups with non-conformities in Incoming Water. The results of 1366 tests, in fact, show that there is a 6% of no compliance in Incoming Water (in which 36 analytes have been tested) against the 2% of no compliance in Raw Wastewater (888 tested analytes) and in Treated

Wastewater (442 tested analytes). Figure 9 shows the number of detections in the three sampling points and it emerges that Raw Wastewater is the most contaminated.

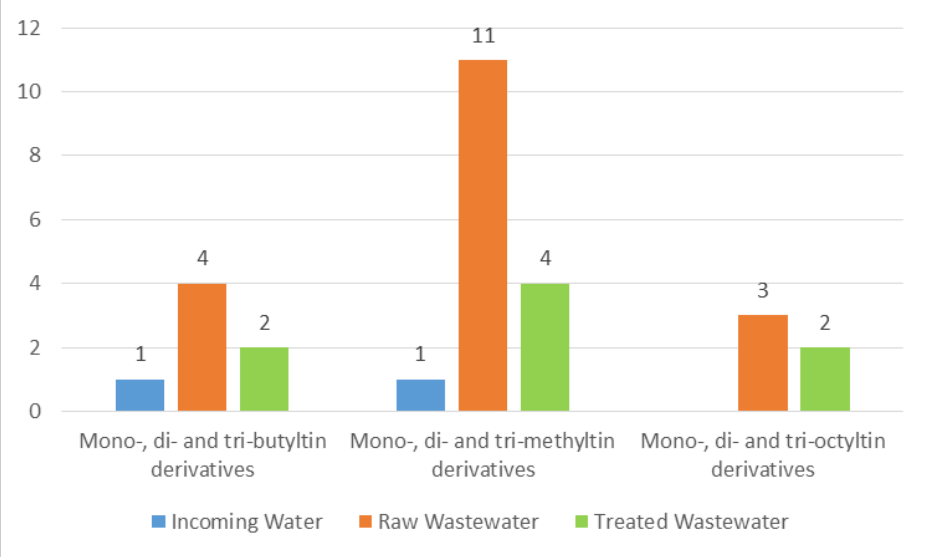

Figure 9 Number of Organotin Compounds' detections.

The higher no compliance in the Incoming Water is justified by the fact that the total number of test is less compared the one made in the other two sampling points: Incoming Water, in fact, is sampled and analyzed only in few cases and often it is to see if contamination is already present. According to detected values in the three different sampling points (see average values in figure 10), the highest values have been found in Incoming Water (0.24 µg/l) and Raw Wastewater (0.19 µg/l).

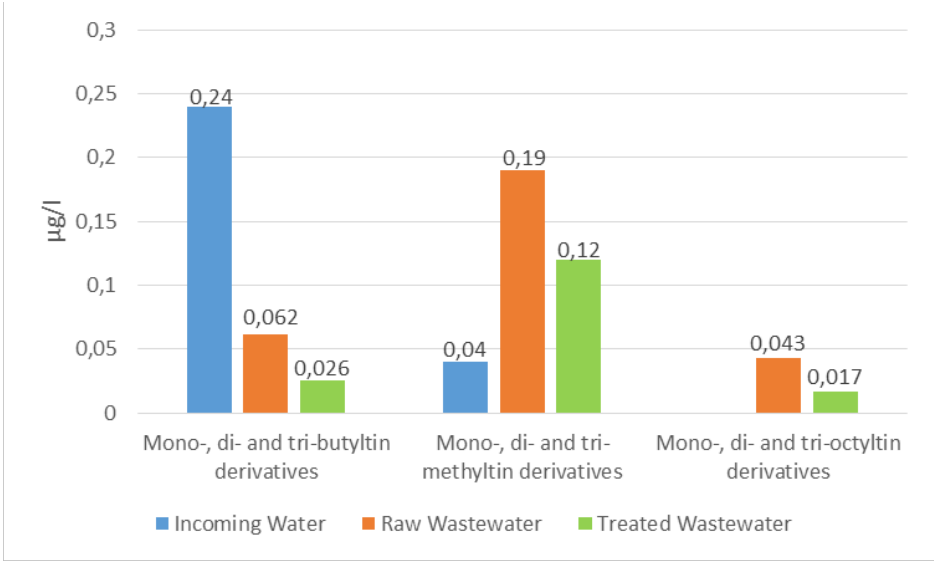

Figure 10 Average values (µg/l) of detected Organotin Compounds.

The total number of facilities with Organotin detections is 15 and they are mainly located in China (figure 11). In particular, in China and Tunisia Organotin Compounds are already present in the Incoming Water.

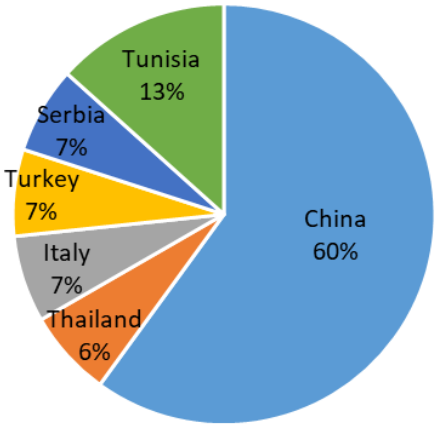

Figure 11 Organotin Compounds' detections by Country.

Perfluorinated and Polyfluorinated Chemicals (PFCs)

PFCs is the group with the highest percentage of detection, especially in Incoming Water (37% of non-compliance). Among 2027 PFCs tested, only 56 exceed ZDHC limits and, among these, 13 (i.e. 23% of the failures) are in the Incoming Water (figure 12). This means that traces found in both Raw Wastewater (2.11% non-compliance) and Treated Wastewater (2.26% non-compliance) could be affected by the incoming impurities[6].

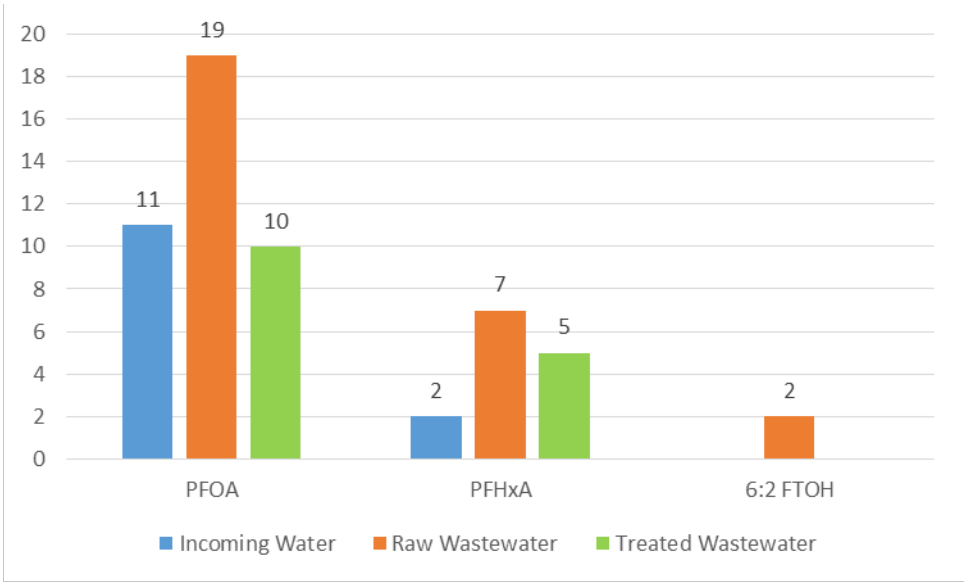

Figure 12 Number of PFCs' detections.

By looking at the detected values, the PFOA and PFHxA average value (0.3 µg/l) is higher than the ZDHC Limit (0.01 µg/l) in all three sampling points, as well as the average detected value of 6:2 FTOH that is higher than 1 µg/l (figure 13).

[6] Taking into account that Incoming Water is the sampling with less number of tested performed.

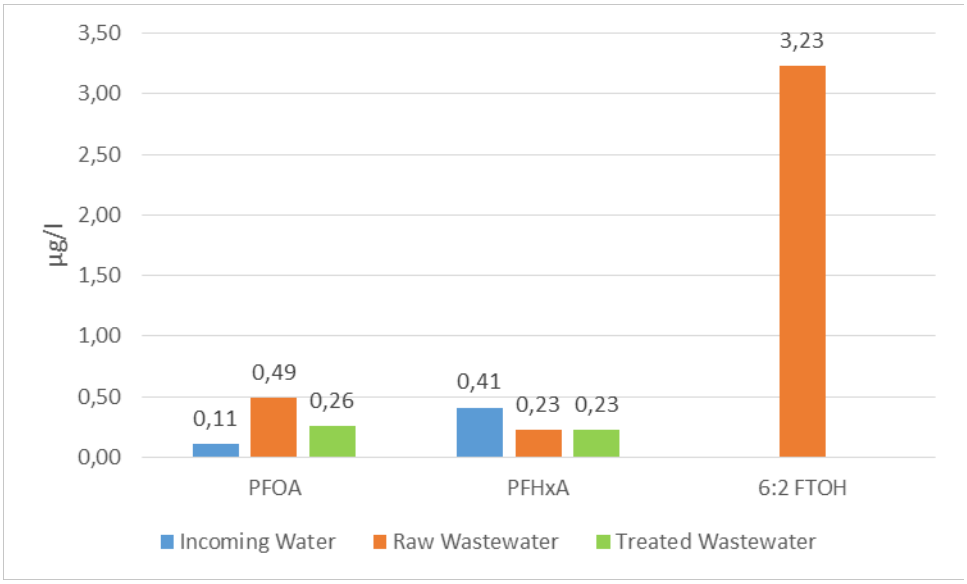

Figure 13 Average values (µg/l) of detected PFOA and PFHxA.

The 19 detections of PFOA in Raw Wastewater belong to 17 facilities located in China. Among those, 5 have detected PFOA in all three sampling points, 4 in the Raw Wastewater and in the Incoming Water, 1 in the Raw and in the Treated Wastewater and 7 only in Raw Wastewater. In addition, a Chinese facility has PFOA detections in Incoming Water and Treated Wastewater and two other facilities (one in China and one in Turkey) that have detected PFOA only in Treated Wastewater.

All the PFHxA's detections have been found in nine facilities located in China. In particular, one facility has detection in all three sampling points, two in the Raw and Treated Wastewater, one only in Treated Wastewater, one in the Incoming Water and in Treaded Wastewater and for facilities only in Raw Wastewater.

Phthalates

The total number of tested analytes belonging to Phthalates is 5392 and percentage of non-compliance is 0.28% and 0.11% in the Raw and in the Treated Wastewater, respectively. This means that Phthalates are almost not present in the process. Among Phthalates analytes (i.e. 16 analytes), in fact, only Di(ethylhexyl) phthalate (DEHP), Di-iso-decyl phthalate (DIDP), Di-isononyl phthalate (DINP), Dibutyl phthalate (DBP), have been detected for a total of 12 findings (figure 14).

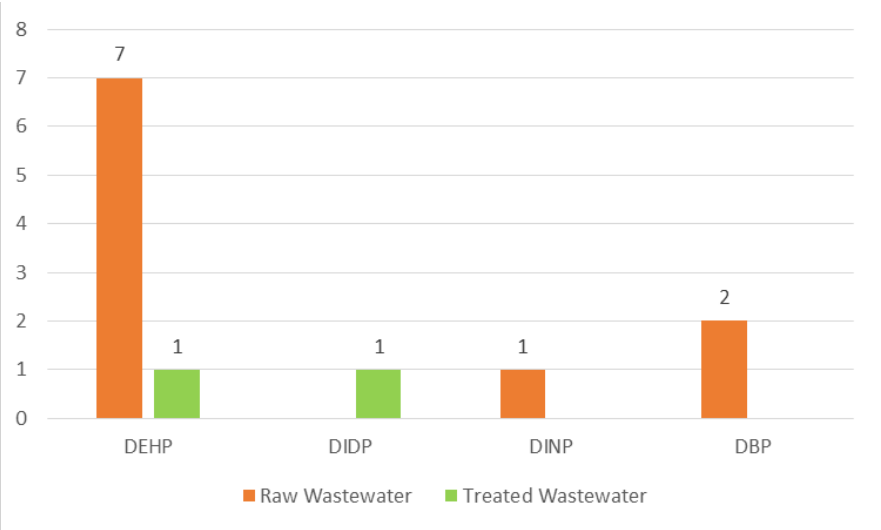

Figure 14 Number of Phthalates' detections.

By looking at the detected average value, it emerges that DEHP's values are very high, both in the Raw and in the Treated Wastewater, compared to those detected for DIDP, DINP and DBP (figure 15).

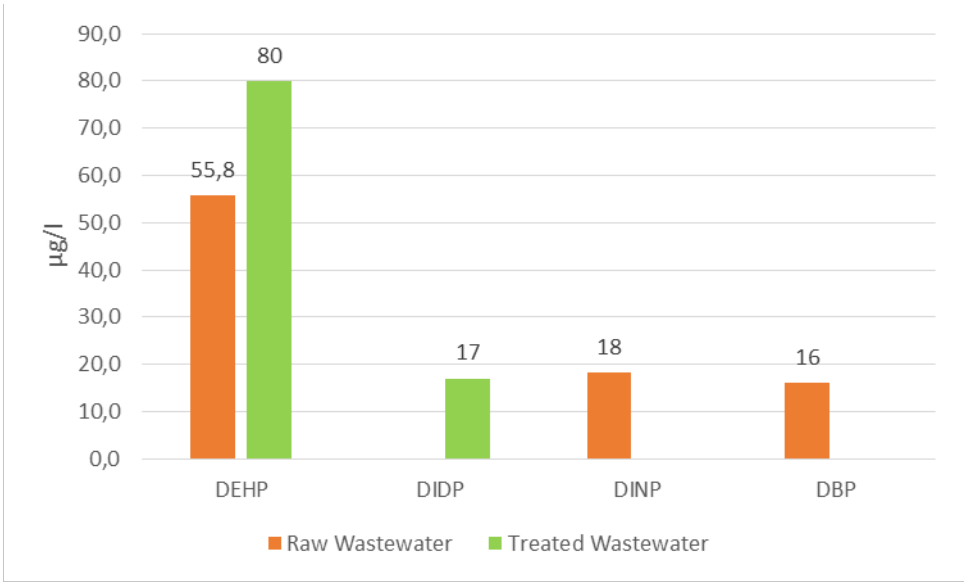

Figure 15 Average detected values of Phthalates.

The total number of facilities with Phthalates detections is 9 and six of them are located in China, while the other three facilities are located in Croatia, Serbia and Turkey. In particular, only the facility located in Croatia has detections in both Raw and Treated Wastewater.

Polycyclic Aromatic Hydrocarbons (PAHs)

The total number of tested Polycyclic Aromatic Hydrocarbons (PAHs) analytes is 6023 whit 6 detections in Raw Wastewater and 3 detections in Treated Wastewater. All detections in Treated Wastewater (i.e. Naphthalene, Pyrene and Fluoranthene) are compliant with ZDHC requirements while all detections in Raw Wastewater (i.e. Naphthalene) are above the limit (figure 16).

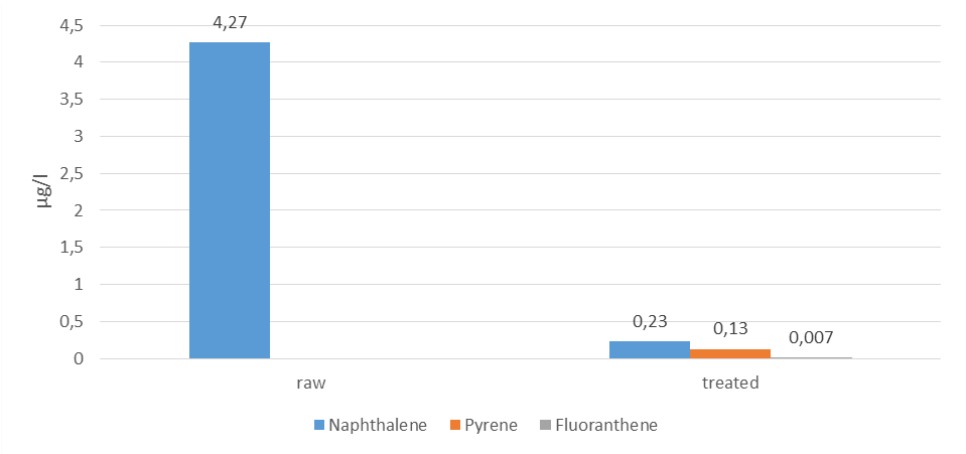

Figure 16 Average detected values of PAHs in Raw and Treated Wastewater.

In particular, detections in Raw Wastewater have been found in six facilities, three located in China and three in Turkey and they do not have any PAHs' detection in Treated Wastewater. All detections in Treated Wastewater belong to a facility located in Italy.

VOC

The total number of tested analytes within the VOC's group is 1714 with only 23 detections, mainly in Raw Wastewater, all above the ZDHC Limit of 1 µg/l, except of one. All detections in the Treated Wastewater exceed the ZDHC Limit (figure 17).

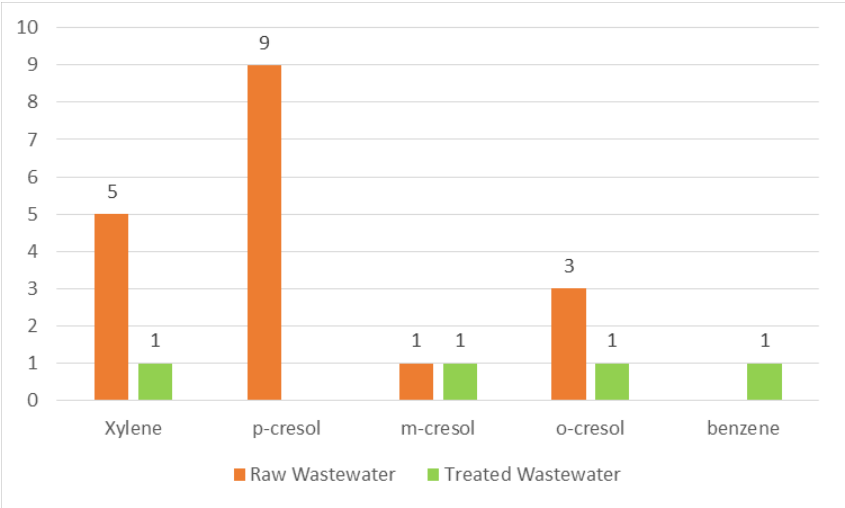

Figure 17 Number of VOC's detections.

All VOC's analytes have been detected: figure 18 shows their average values.

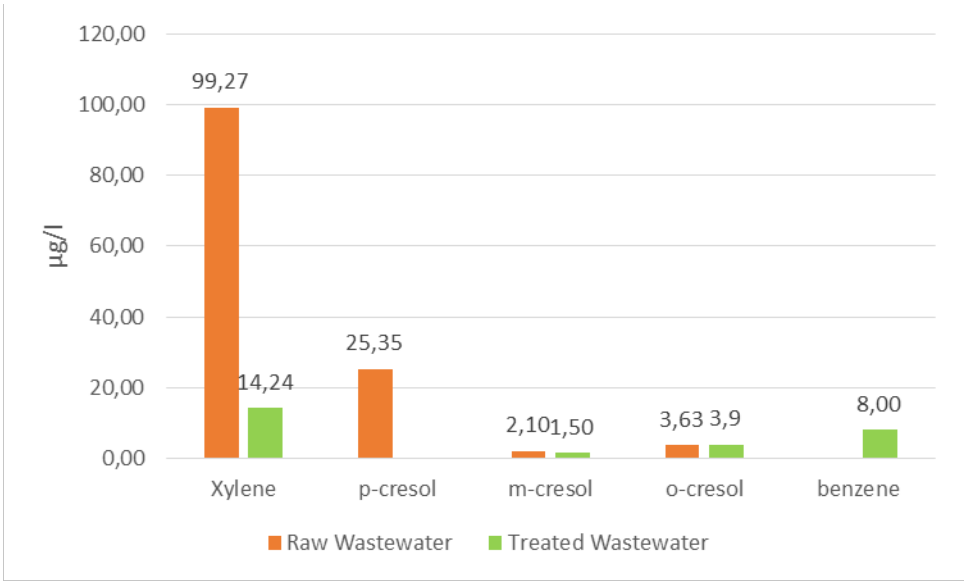

Figure 18 Average detected values of VOC.

The 23 detections of VOC have been found in six facilities located in China, three in Italy, two in Turkey, one in Tunisia, Croatia, Serbia, Egypt, Brazil and Portugal. All facilities have VOC only in Raw Wastewater, while the Serbian and the Brazilian ones have VOC also in the Treated Wastewater. Only one Turkish facility has detected VOC only in Treated Wastewater.

2. HEAVY METALS

Heavy Metals group has been analyzed in Incoming Water, Raw Wastewater and Treated Wastewater with 4009 tested analytes. In particular, by looking at the Incoming Water, results show that it is already polluted (figure 19): major detections have been found for Zinc, Nickel, Copper and Arsenic followed by Chromium total, Antimony, Mercury, Cadmium and Lead, while there are no detection (or close to null) of Chromium (VI), Cobalt and Silver.

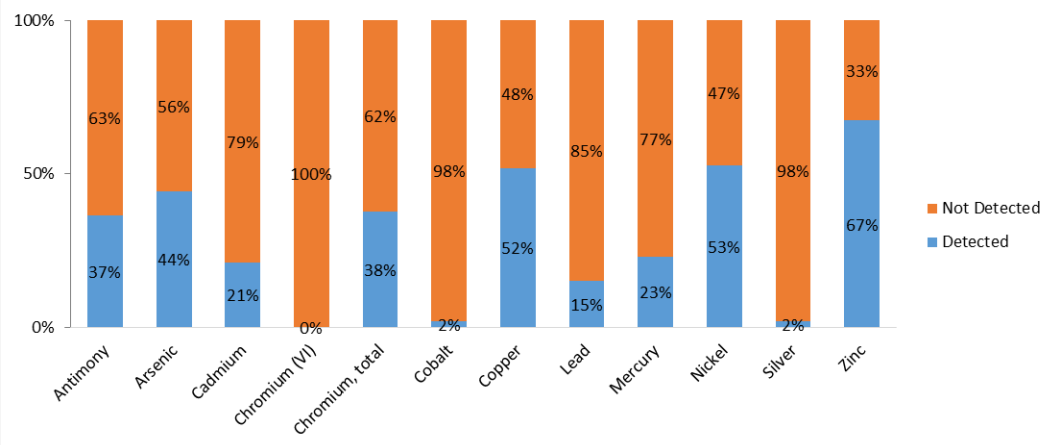

Figure 19 Heavy Metals' detections in Incoming Water.

As shown in figure 20, detections have been found mainly in China (81%). Turkey and Italy account, respectively, for 10% and 5%, and the remaining 4% is represented by detections in Cambodia, Croatia, Thailand and Egypt. In particular, the only Cobalt and Silver's detections have been found in China.

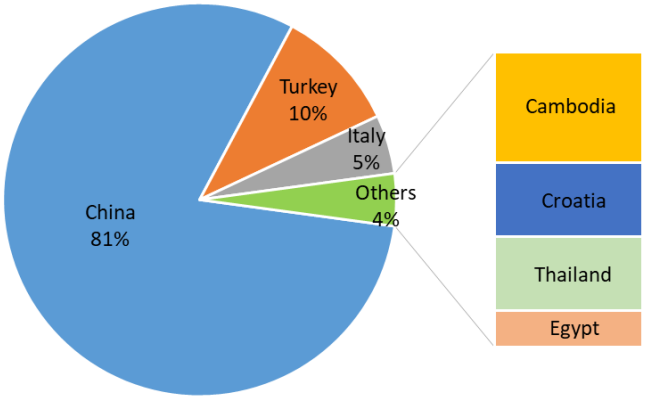

Figure 20 Heavy Metals' detections in Incoming Water by countries.

Regarding Raw Wastewater, results show a very high compliance with ZDHC requirements for all Heavy Metals: on 2120 tested analytes, detections represent around 40% and, among those, only 33 of them (that is around 2%) are above the Foundational Level. Figure 21 shows the compliance of each heavy metal by considering not detections within the Aspirational Level.

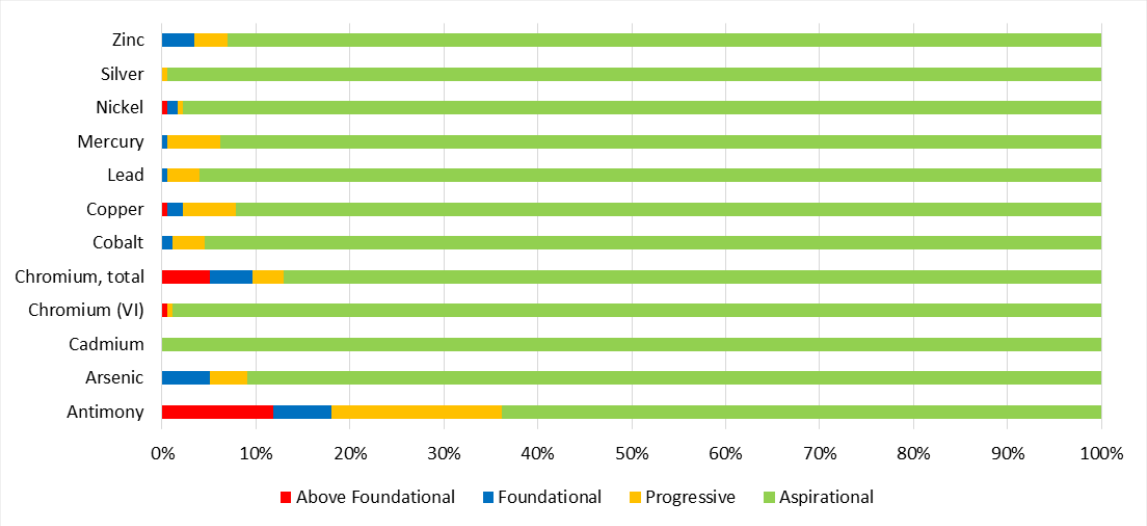

Figure 21 Heavy Metals' compliance in Raw Wastewater.

The heavy metals exceeding the ZDHC Foundational Level are Antimony, Chromium total, Chromium (VI), Copper and Nickel. In particular, among the 33 detection above the limit, Antimony is the substance with higher detection, followed by Chromium total with an account of 63% and 3% on the total, respectively.

The total number of Heavy Metals test performed in Treated Wastewater is 1910 and detections represent the 32% of which only 0.5% is above the ZDHC Foundational Level. Figure 22 represents the total compliance of Heavy Metals in Treated Wastewater by considering not detections within the Aspirational Level.

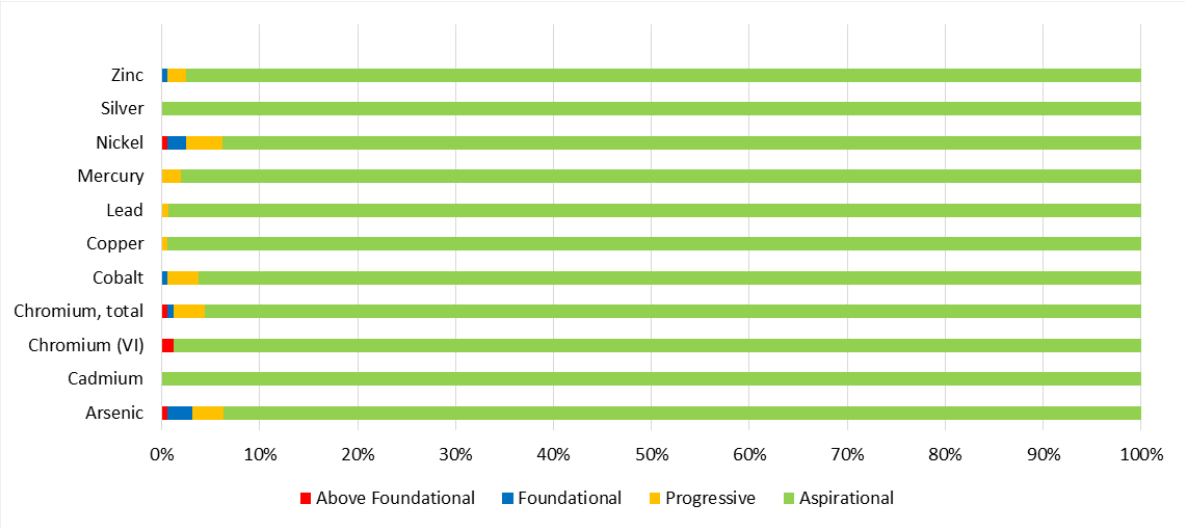

Figure 22 Heavy Metals' compliance in Treated Wastewater.

The heavy metals exceeding the ZDHC Foundational Level are Antimony, Chromium (VI), Chromium total, Arsenic and Nickel. In particular, Antimony is the main detected substance also in Tretated Wastewater, accounting for 50% of the total detection above the limit.

By looking at the number of detections (both in the Raw Wastewater and in the Treated Wastewater) by Country, China is the one with the highest value with 48.4% of the total detections. It is followed by Turkey (22.5%), Bangladesh, India, Italy and Portugal (with values between 2% and 10%), while other countries (Egypt, Thailand, Spain, Morocco, Pakistan, Cambodia, Croatia, Bulgaria, Serbia and South Korea) have detections for less than 2%. Moreover, in China, all metals have been detected both in Raw Wastewater and in Treated Wastewater, including Chromium VI, Mercury and Silver that are those with the lowest number of detection (8% of the total). Traces of these metals have been found also in Egypt, India, Italy, Thailand and Turkey and in most of the cases, there are no any detection in the Treated Wastewater. Figure 23 represents detections of Antimony, Arsenic, Chromium total, Cobalt, Copper, Lead, Nickel and Zinc by Country.

Figure 23 Main Heavy Metals' detection in Raw Wastewater (RW) and Treated Wastewater (TW) by Country.

3. ANIONS

The group of Anions is constituted by Cyanide, Sulfide and Sulfite and the total number of test performed in the three sampling points is 708, of which only 2 in the Incoming Water.
By looking at the results of 706 test performed in Raw Wastewater (154) and Treated Wastewater (552), the total compliance of Anions represents more than 70%, even if some results exceed the Foundational Level (figure 24).

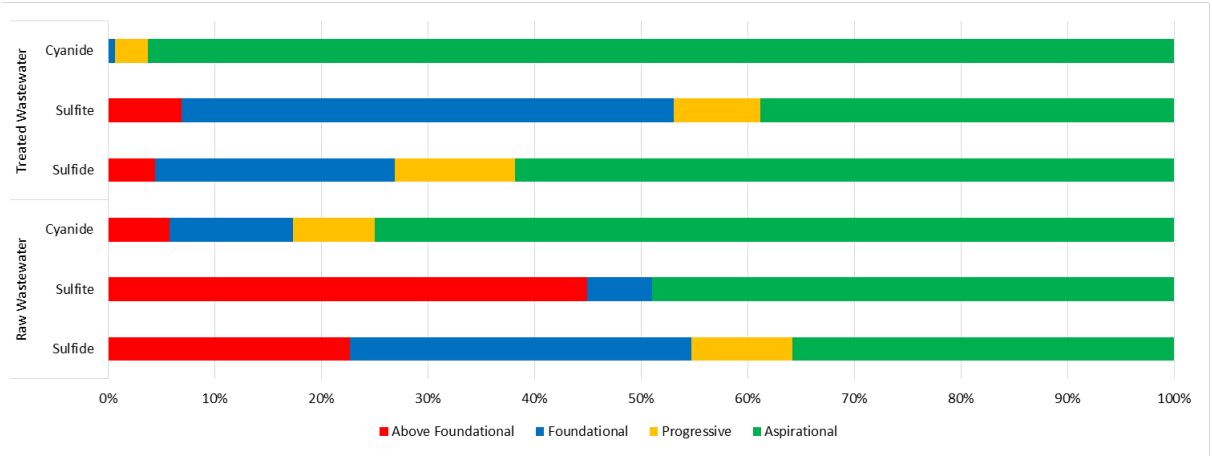

Figure 24 Anions' compliance in Raw Wastewater and Treated Wastewater.

In Figure 25, the detected average values for each anion are represented: higher values are found in Raw Wastewater and Sulfite is the substance with highest detections.

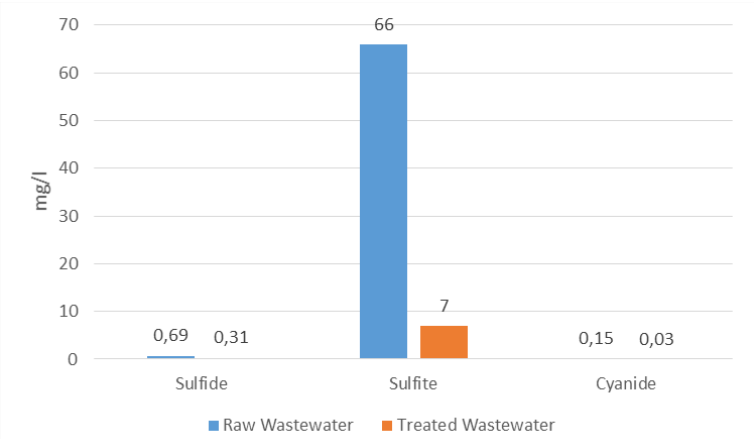

Figure 25 Detected Average values of Anions in Raw Wastewater and Treated Wastewater.

By looking at the presence of Anions in Raw Wastewater by country, it emerges that: in Portugal, there is no trace of Sulfide, in Italy there is no trace of Sulfite and in India and Bangladesh there is no trace of Cyanide (figure 26).

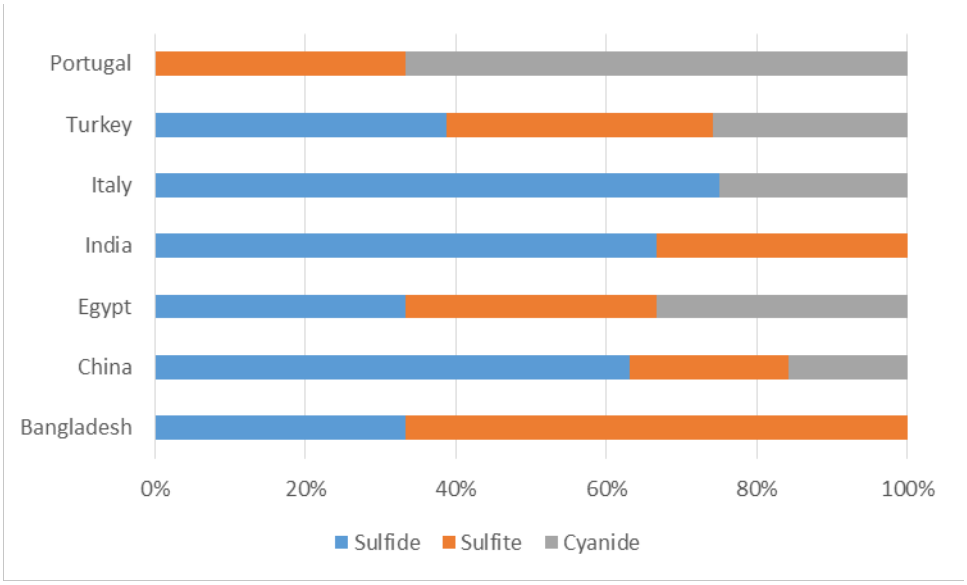

Figure 26 Anions' detections in Raw Wastewater by Country.

Regarding Treated Wastewater, as shown in figure 27, Italy and Croatia are the countries where Sulfide is mainly detected. Cyanide is present in the Treated Wastewater of some facilities located in China, Egypt, India and Turkey.

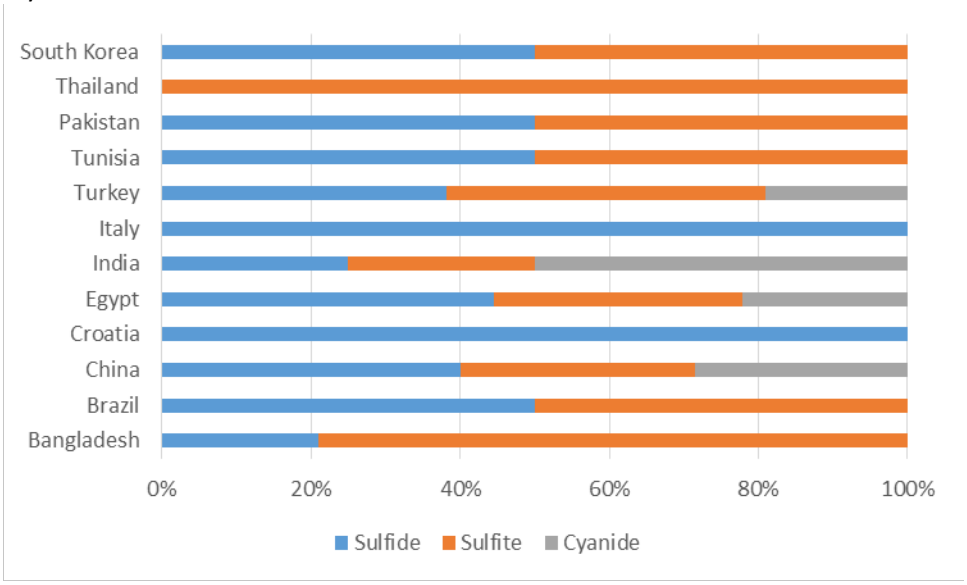

Figure 27 Anions' detections in Treated Wastewater by Country.

4. CONVENTIONAL PARAMETERS

As already noted, in this work Conventional Parameters refer to the Sum Parameters defined in Appendix A of the ZDHC Wastewater Guideline v.1.1. In this section results of tests made in facilities having direct discharge (i.e. having an own ETP) are analyzed.

These parameters, in fact, mostly refer to the proper functioning of an ETP and they can be briefly summarized in temperature, pH, biological oxygen demand (BOD5) or chemical oxygen demand (COD), that's the reason why it has no sense to test them in wastewater before treatment, unless supplier uses a centralized effluent treatment plant (CETP). In this specific case, these parameters should be compliant with the legal discharge permit and/or receiving CETP limits that could be different from ZDHC requirements.

In 2021, facilities with direct discharge represent 30% of the wet process suppliers working with Benetton and, according to the obtained tests' results, among 1402 tested parameters, only 7% of them are above Foundational Level. In particular, values exceeding Foundational Level are always lower than 10% for each tested parameter (figure 28), except for Coliform and BOD5 that exceed foundational limit for 22% and 11% respectively.

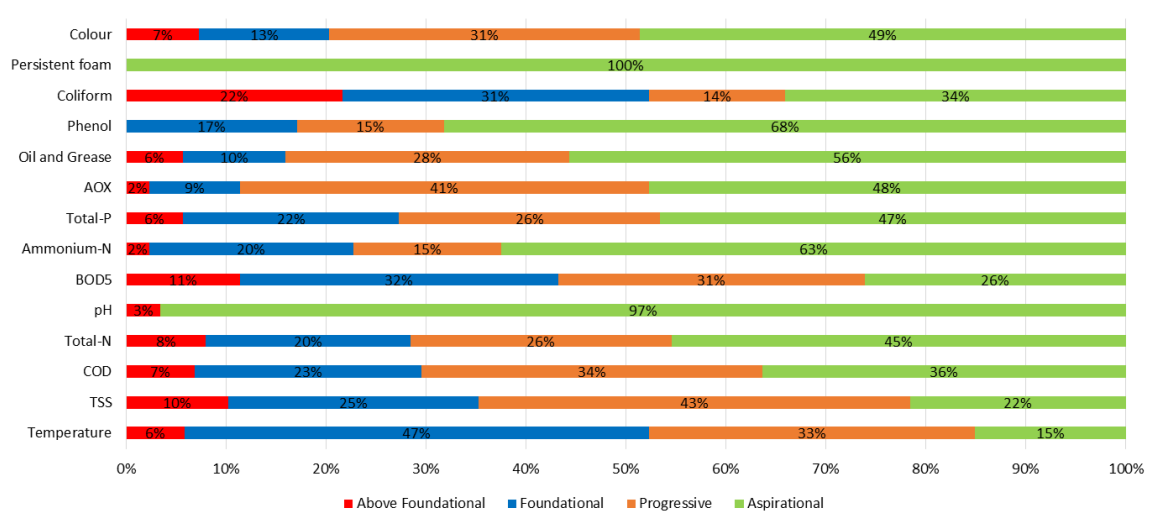

Figure 28 Conventional Parameters' compliance.

Test results of pH and Persistent Foam can be either compliant or not compliant, therefore we consider them as aspirational and above foundational level respectively. With this assumption, results show that 93% of tested parameters meet ZDHC requirements. In particular, 703 parameters (that is 50% of the total) already meet the Aspirational Level while the remaining 43% is divided between Foundational (i.e. 258 parameters) and Progressive Level (349 parameters). Persistent Foam is 100% compliant while pH shows a 3% not compliant with ZDHC requirements. In conclusion, this means that almost all wet process suppliers are in line with local requirement in each country. All Conventional Parameters, in fact, are tested according to standard methods that have been made equivalent across different regions (i.e., Europe, United States and China) but where stricter legal, local or regional wastewater limits are in place, these last values shall supersede those defined in the ZDHC Wastewater Guidelines.

Compared to 2019 and 2020, even if some suppliers have been changed during the years, results show a general improvement regarding Conventional Parameters' compliance. As shown in figure 29, in fact, there is a decrease in the number of substances that exceed the Foundational Level (from 13% to 7%) and in the number of those meeting the Foundational Level (from 21% to 18%). The compliance's percentage of progressive level remain around 23% while there is an increase of 8% (from 42% to 50%) for those within the Aspirational Level.

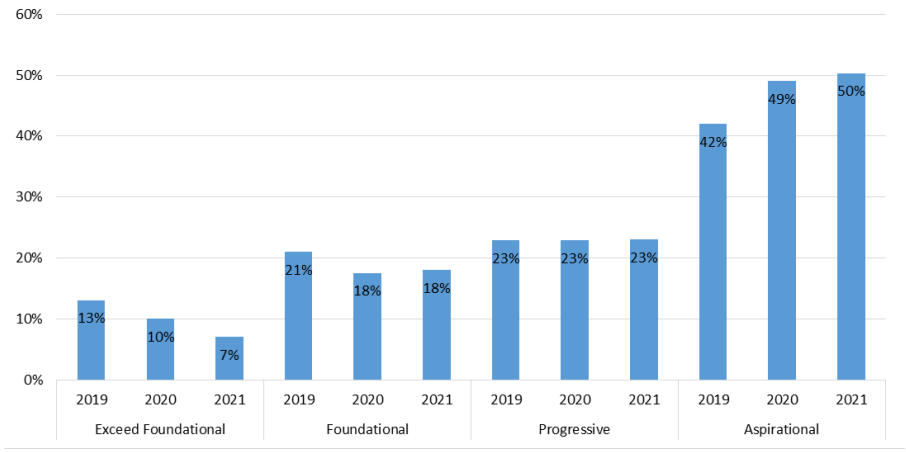

Figure 29 Conventional Parameters' compliance among the years.

Conclusion

Textiles industry is one of the major user of hazardous chemicals and industrial polluter of freshwater but since the beginning of the Greenpeace Detox campaign (in 2011), many progresses have been reached even if the goal of the total elimination of the hazardous chemicals has not been accomplished yet.

From our results, in fact, it emerges that some hazardous chemicals are still present in discharged water and this could be associated either with the already presence in the incoming water or with the use of those substances in the process, meaning that the Chemical Inventories of the suppliers are not fully aligned with the ZDHC parameters yet. It has to be noted that, to be truthful, the presence of some substances very low detected could probably derive from impurities in chemicals or commodities.

Independently from the obtained results in 2021, Benetton will continue encouraging its suppliers to achieve a cleaner production and it will enforce the control on the suppliers input chemicals management. Moreover, together with other brands, Benetton will continue enhancing the visibility of ZDHC and SAC tools to improve the supply-chain performance and to analyze the results as a "global" industry.