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**STUDY AND REPORT ABOUT CHANGING THE STRUCTURE OF WATER WITH  
THE METAL FILTER “AQUA SANITAS”**

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*Glava vsake strani poročila:*

Bion, Institute Study and report about changing the structure of water with the metal filter  
Aqua Sanitas

## “BION EVAPO” METHOD

“Bion Evapo” Method (BEM) is a standardized research method about the changes of water structure, which occur due to various factors. The method is carried out under controlled conditions, such as humidity, temperature, the immediate surrounding electric and magnetic field, both in terms of intensity and orientation. The deliberate combination of methods and procedures can observe and evaluate structural changes that cannot be measured by conventional methods. With BEM we analyze samples of solids that remain on the glass object after the water drops are drained. In the dark field we use the microscopy to analyze the forms which occur in different conditions, and the pictures are evaluated with specific software program for capturing and analysis of texture picture. BEM is a method with high reproducibility.

## ANALYSIS

First we analyzed water samples without the metal bottle Aqua Sanitas. Then we filled the bottle Aqua Sanitas in accordance with the instructions and we analyzed water samples after 10 minutes, 30 minutes and at last after 60 minutes of filtration. Each time we measured the content of total dissolved solids (TDS – total dissolved solids), and after 10 and 60 minutes, the beads were prepared for microscopic analysis. On a cleaned glass object we dropped the water samples which we evenly dried (evaporation) in controlled conditions and we observed the rest of the solids under a microscope in a dark field.

*Slika 1: Objektno steklo s svežimi (zgoraj) in suhimi kapljicami (spodaj).*

Picture 1: Fresh (top) and dry (below) droplets on the objective glass.

The resulting pictures were analyzed by a so-called matrix neighborhood method GLCM (Grey Level Co-Occurrence Matrix), which compares the intensity and distribution of pixels. We determined the parameters of texture that helped us to compare the leavings of different drops to each other. We evaluated differences in the areas within the droplets (edge, center) and monitored the trends of changing textures and patterns formed by water during the experiment.

Testing textures parameters:

- ASM (Angular Second Moment) – a measure of homogeneity
- Contrast – a measure of linear dependence between pairs of shades of gray pixels on specific location
- Correlation – a measure of coherence pairs of pixels in the whole image/part of it
- Entropy – a measure of disorder of the picture/part of it

Samples of water that were tested before and after the use of Aqua Sanitas:

We tested 6 different kinds of water: distilled water, tap water, two kinds of water with a low content of dissolved particles (TDS of about 200 ppm) and also 2 kinds of water with a high content of dissolved particles (TDS > 1200 ppm).

- Distilled water (DV) (0 ppm TDS)
- Tap water plumbing Ljubljana (VV) (329 ppm TDS)
- Test Water 1 (TV-1) - spring water (200 ppm TDS)
- Test Water 2 (TV-2) - natural mineral water (190 ppm TDS)
- Test Water 3 (TV-3) - natural mineral water (TDS 1,290 ppm)
- Test Water 4 (TV-4) - natural mineral water (TDS 1,620 ppm)

## RESULTS

The demonstrated results do not represent any special and personal selection of pictures, as the droplet's appearance and texture are same (Picture 2), from that reason the results are not statistically evaluated.

*Slika 2: Posušene kapljice Testne vode 4 pred poskusom (levo) in po 60 minutah filtriranja v Aqua Sanitas.*

Picture 2: Dried drops of tested water number 4 before the experiment (left) and 60 minutes later after the filtration of Aqua Sanitas.

*Tabela 1: Vsebnost raztopljenih delcev (TDS) v vzorcih vode pred poskusom in spreminjanje vsebnosti delcev med poskusom (ppm)*

Tabel 1: Concentration of dissolved particles (TDS) in water samples before the experiment and changes of the content of particles during the experiment (ppm).

	Before the experiment	After 10 Min	After 30 Min	After 60 Min
Distilled Water	0	15	34	80
Waterworks	319	304	302	285
Test water 1	200	241	265	252
Test water 2	192	246	273	262
Test water 3	1290	1540	1680	1760
Test water 4	1620	1720	1920	2060

## **Distilled water (DW)**

Picture 3: The picture is showing the rest of a droplet of distilled water before the experiment (left) and then 30 minutes after the filtration with Aqua Sanitas (right) (40 × zoom).

The leavings of the droplet of a distilled water before the experiment was expected – as distilled water doesn't and shouldn't have ingredients that would form any structure. But filtered distilled water from Aqua Sanitas formed an interesting pattern with strongly enhanced and multi-layer edge and with the patterns of holes, which continues to the bigger part of the edge. The center of the droplet is unstructured.

Table 2: Parameters of the texture analysis about a sample of distilled water after 30 Minutes in the Aqua Sanitas (ASM – Angular second moment, the analysis was done by capturing one pixel at an angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM

Kontrast = Contrast

Korelacija = Correlation

Entropija = Entropy

Kot = Angle

Cela kapljica = Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

## **Tap Water (TW)**

Picture 4: Droplets of the tap water before testing (left), after 10 Minutes (in the middle) and after 60 Minutes (right) (40 × zoom)

The leavings of the droplet of a tap water before testing are a typical example of a tap water without any special structure and with fairly part's distribution a droplet with a clear, but not reinforced edge. During the experiment we noticed the moving of some parts from the center to the edge, where after 60 Minutes came to the clearly identifiable part of the boundary, while the center remains empty and unstructured.

Table 3: Parameters of the texture analysis about the samples of tap water before using the tap water in Aqua Sanitas, after 10 Minutes in Aqua Sanitas and after 60 Minutes in Aqua Sanitas (ASM – Angular second moment; analysis made by the capture of one pixel and an Angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM

Kontrast = Contrast

Korelacija = Correlation

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Cela kapljica = Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

### **Tested water 1 (TW-1)**

Picture 5: Water droplets from the Tested Water 1 with low-dissolved particles before testing (left) and after 10 minutes (in the middle) and after 60 minutes (right) (40 × zoom).

Tested water 1 showed tend to regulate the boundary area before the experiment and in the center you almost don't notice the leavings of particulate matters. After filtering the water for 10 minutes, the boundary area got stronger and formed interesting blue colored area. We also noticed reinforced outer edge. After filtering the water for 60 minutes, the blue area reorganized, and we noticed even stronger recuperation and structure of the outer edge and a compact distribution of the particles around the entire droplet. The center remained unregulated.

Table 4: Parameters of the texture analysis about the samples of tested water 1 (TW-1) before using the tap water in Aqua Sanitas, after 10 Minutes in Aqua Sanitas and after 60 minutes in Aqua Sanitas (ASM – Angular second moment; analysis made by the capture of one pixel and an Angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM

Kontrast = Contrast

Korelacija = Correlation

Entropija = Entropy

Kot = Angle

Pred Aqs Cela kapljica = Before Aqs Entire Droplet

Rob (spodaj) = Edge (down)

Središče = Center

Aqs 10 min cela kapljica = Aqs 10 min Entire Droplet

Rob (zgoraj) = Edge (up)  
Rob (spodaj) = Edge (down)  
Središče = Center  
Aqs 60 min cela kapljica = Aqs 60 min Entire Droplet  
Rob (zgoraj) = Edge (up)  
Rob (spodaj) = Edge (down)  
Središče = Center

### **Tested Water 2 (TW-2)**

Picture 6: Water droplets from the Tested Water 2 with low-dissolved particles before testing (left) and after 10 minutes (in the middle) and after 60 minutes (right) (40 × zoom).

Tested water 2 showed a clear edge and wide rim residue particles before the experiment. During the experiment the particles moved to the edge where it came to the form of a highly structured and settled edge, while the regulation of the center went lower.

Table 5: Parameters of the texture analysis about the samples of tested water 2 (TW-2) before using the tap water in Aqua Sanitas, after 10 Minutes in Aqua Sanitas and after 60 Minutes in Aqua Sanitas (ASM – Angular second moment; analysis made by the capture of one pixel and an Angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM  
Kontrast = Contrast  
Korelacija = Correlation  
Entropija = Entropy  
Kot = Angle  
Pred Aqs Cela kapljica = Before Aqs Entire Droplet  
Rob (spodaj) = Edge (down)  
Središče = Center  
Aqs 10 min cela kapljica = Aqs 10 Min Entire Droplet  
Rob (zgoraj) = Edge (up)  
Rob (spodaj) = Edge (down)  
Središče = Center  
Aqs 60 min cela kapljica = Aqs 60 Min Entire Droplet  
Rob (zgoraj) = Edge (up)  
Rob (spodaj) = Edge (down)  
Središče = Center

### **Tested water 3 (TW-3)**

Picture 7: Water droplets from the Tested Water 3 with a high proportion of dissolved particles before testing (left) and after 10 Minutes (in the middle) and after 60 Minutes (right) (40 × zoom).

Tested water 3 had very complex organized edge before the testing, which is noticeable in particular at the bottom of droplet. 10 Minutes after the filtering, this structure is broken; the droplet is much regularly filled up and doesn't show specific structures. 60 Minutes after the testing we see a homogeneous droplet with a high complexity. Different spirals and concentric structures, which are not confined only to the edge like in previous tests, appear.

Table 6: Parameters of the texture analysis about the samples of tested water 3 (TW-3) before using the Aqua Sanitas, after 10 Minutes in Aqua Sanitas and after 60 Minutes in Aqua Sanitas (ASM – Angular second moment; analysis made by the capture of one pixel and an Angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM

Kontrast = Contrast

Korelacija = Correlation

Entropija = Entropy

Kot = Angle

Pred Aqs Cela kapljica = Before Aqs Entire Droplet

Rob (spodaj) = Edge (down)

Središče = Center

Aqs 10 min cela kapljica = Aqs 10 Min Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

Aqs 60 min cela kapljica = Aqs 60 Min Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

## Tested water 4 (TW-4)

Picture 8: Water droplets from the Tested Water 4 with a high proportion of dissolved particles before testing (left) and after 30 Minutes (in the middle) and after 60 Minutes (right) (40 × zoom).

Also this tested water 4 has highly structured boundary area before testing, which reorganizes into a homogeneous, highly complex structure that fills the entire droplet after 10 Minutes in Aqua Sanitas, but the arrangement here is higher in the peripheral area at the edge than in the center.

Table 7: Parameters of the texture analysis about the samples of tested water 4 (TW-4) before using the Aqua Sanitas, after 30 Minutes in Aqua Sanitas and after 60 Minutes in Aqua Sanitas (ASM – Angular second moment; analysis made by the capture of one pixel and an Angle of 0 ° and 90 °). The units are arbitrary, excluding the parameter Angle, where the degrees are given.

*Tabela prevodi:*

ASM = ASM

Kontrast = Contrast

Korelacija = Correlation

Entropija = Entropy

Kot = Angle

Pred Aqs Cela kapljica = Before Aqs Entire Droplet

Rob (spodaj) = Edge (down)

Središče = Center

Aqs 10 min cela kapljica = Aqs 10 Min Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

Aqs 60 min cela kapljica = Aqs 60 Min Entire Droplet

Rob (zgoraj) = Edge (up)

Rob (spodaj) = Edge (down)

Središče = Center

*Slika 9: Pri sušenju kapljic v nekontroliranih pogojih se lahko tvorijo različne oblike. Na fotografiji je ostanek kapljice vodovodne vode iz Aqua Sanitas.*

Picture 9: While drying up the droplets in uncontrolled conditions, various shapes can form. This picture shows the rest of a droplet's from a tap water from the Aqua Sanitas.

The Tables 5, 6 and 7 are showing bold marked value of pairs, which widely distinguish in the analysis at different angles. The big difference in the value indicates a high order in a given direction, therefore the stratification of texture in the study area. This phenomenon is especially frequent in waters with high TDS (tested water 3 and 4).

*Slika 10: Spreminjanje parametra ASM pri testni vodi 4*

Picture 10: Changing the parameter ASM in the test water number 4

Picture number 10 shows modifying the parameter ASM during the experiment in the whole droplet (left) and on the edge and in the center (right) in the test water 4 (high TDS). ASM is decreasing in the whole droplet, which means, that the arrangement of the crystal texture during the experiment increases. ASM of the peripheral area is also decreasing, as the arrangement around the corner increases. Growing ASM in the central area shows meanwhile the smaller arrangement of this area at the end of the experiment.

*Tabela prevod:*

Pred poskusom = Before testing

Po 30 min = After 30 min

Po 60 min = After 60 min

ASM = ASM

Cela kapljica = Entire Droplet

Rob = Edge

Sredina = Center

Kontrast = Contrast

*Slika 11: Spreminjanje kontrasta pri vodovodni vodi*

Picture 11: Contrast changing in the tap water

Tap water hasn't shown significant differences between "Evapo" pictures of water before the testing and after 10 minutes of filtration with Aqua Sanitas. The differences showed up after 60 minutes. Picture number 11 shows the change of contrast in the tap water. Growing contrast means better regularity and less complexity. The contrast of entire droplets during the experiment is also growing, after 60 minutes the contrast is as twice as bigger than the contrast before the experiment. Here, too, we notice higher regularity around the boundary area, if compared to the center of the droplet. An interesting trend was observed about the

tested water number 3, where there has come to the reordering structures (Picture number 12). Contrast increased in the entire droplet after 10 minutes, which refers its fragmented structure. After 60 minutes the contrast decreased (3,6-times depending on the contrast value at 10 minutes), because it came to the form of a completely new structure.

Tabela prevod:

Cela kapljica = Entire droplet

Rob = Edge

Sredina = Center

Kontrast = Contrast

Pred poskusom = Before testing

Po 10 min = After 10 min

Po 60 min = After 60 min

*Slika 12: Spreminjanje kontrasta pri Testni vodi 3.*

Picture 12: Contrast changing in a Test water number 3.

## **DISCUSSION WITH CONCLUSION**

The Analyses of different kinds of water, which have been filtered in the metal bottle Aqua Sanitas, showed its different responses to the filtration. Referring to the Table 1, the content of dissolved particles is changed at every kind of water. There were bigger changes about the content of dissolved particles at the kinds of water which already have higher values of TDS.

Structure of the leavings of water droplets was changing (varied) during the experiment. The differences between the samples of leavings of residual solids are clearly observed already at the first glance, which was also confirmed through detailed analysis of the textures (especially the parameters ASM and Contrast).

Changes and differences during the experiment between droplets of different kinds of water are most noticeable in the peripheral area. At the beginning, the structures in the water has been ordered randomly, but in the course of time it comes to the edge forming, which may be thickened and reinforced, where also some different crystal patterns are present. Meanwhile the center of a droplet remains more or less unchanged and the complexity of the texture in center even reduces.

The kinds of water that have high TDS (Tested water number 3 and 4) get increased not only by homogeneity, but also by the complexity of the textures and subtle tidiness, while the low TDS (Tested water number 1 and 2) showed an increased heterogeneity

The study clearly confirms the effects of the metal bottle towards a better structure, better regulation and enrichment of the water structures, which is particularly evident on the Picture number 8. Therefore, the metal filter Aqua Sanitas may obtain a certificate for quality of water's structure.