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# **Mechanism of Harmful Impurities, Viruses and Bacteria Removal from Water By Aragon BIO Material.**

## **Recent Test Results From Europe and Russia.**

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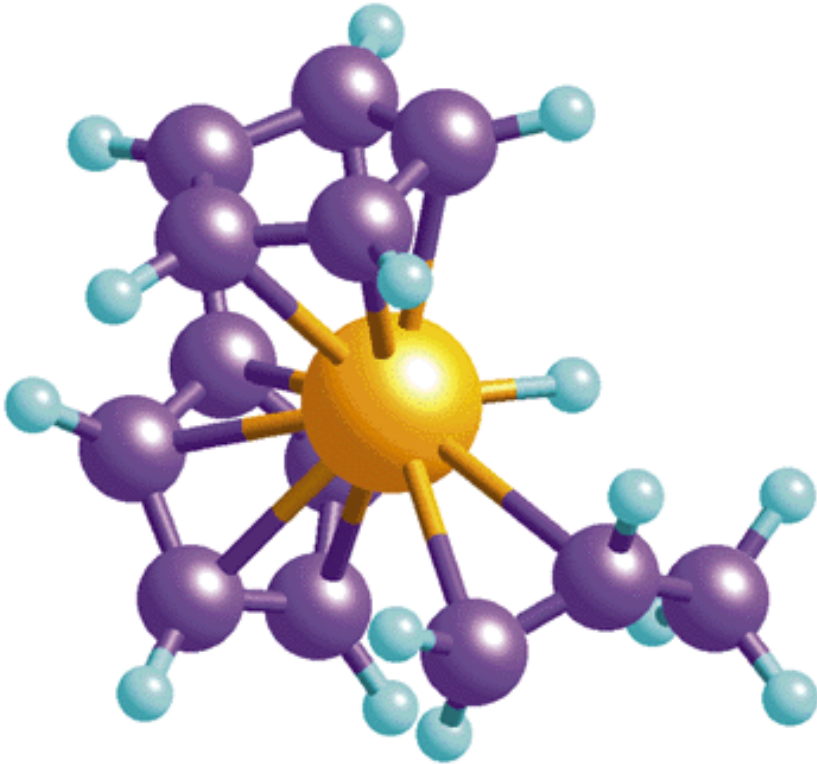
Saint Petersburg, 2014



# ARAGON

UNIQUE FILTERING MATERIAL

# SGS-Polymers



**In 1988**, the high molecular compounds, **SGS-polymers** were first prepared. They have both **cation-** and **anion-**exchange properties.

# ARAGON is a Resorcinol–Based Polymer

Best Water Decontamination Performance (2001)

**Resorcinol**— meta-dihydroxybenzene.

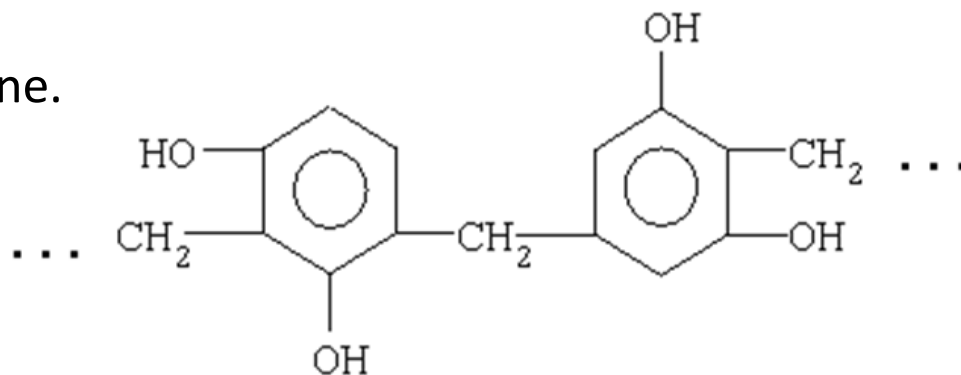
Formula: C<sub>6</sub>H<sub>6</sub>O<sub>2</sub>

Molecular weight: 110.1 g/mol

Melting point: 110 °C

Density: 1.28 g/cm<sup>3</sup>

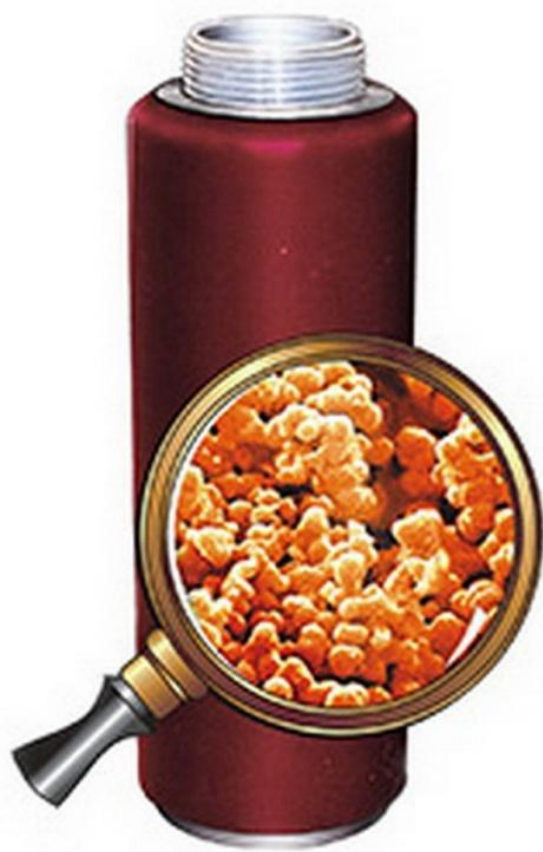
Boiling point: 277 °C



**ARAGON** is a compound polymeric material presented as a single block, with a bacteriostatic silver addition.



# SGS-Polymer Filtering Cartridge



The SGS-polymer's structure is formed by **spherocolloids** with the size of **1 to 3-7  $\mu\text{m}$**  (which is **2 orders of magnitude less** than standard granulation ion-exchanging materials (0.5-0.7 mm)), therefore volumetric flow rates of solutions through the SGS-polymer are significantly higher.

The spherocolloids form a regular highly-permeable porous structure.

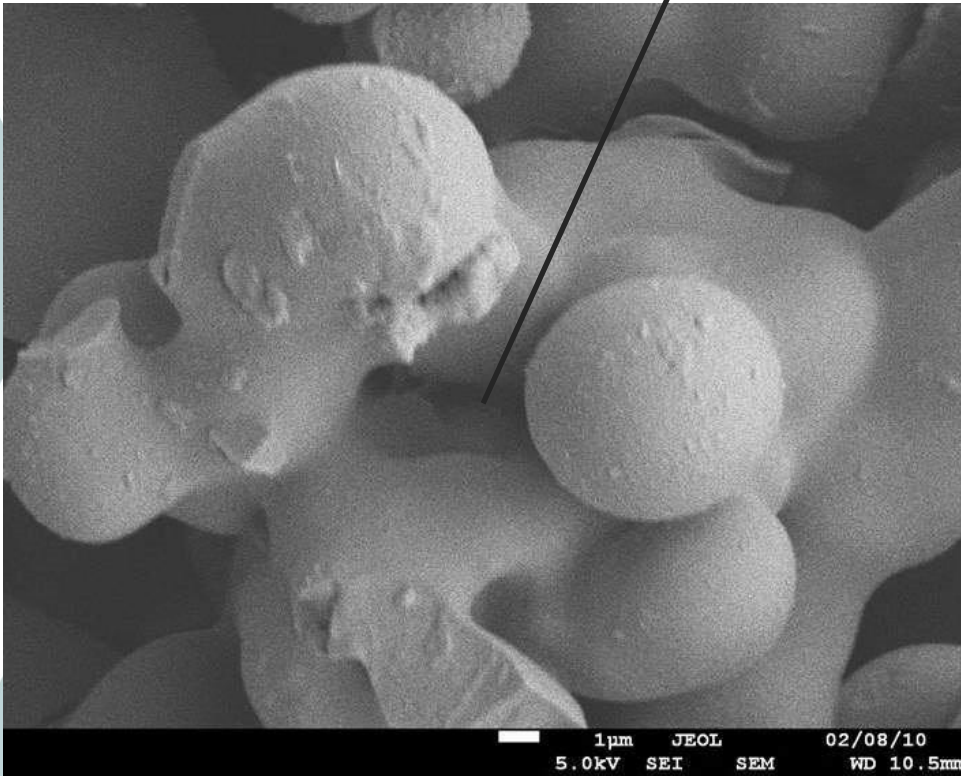
**Pores' sizes distribution is  $\pm 10\%$ .**

# Spherocolloids



1  $\mu\text{m}$

pore



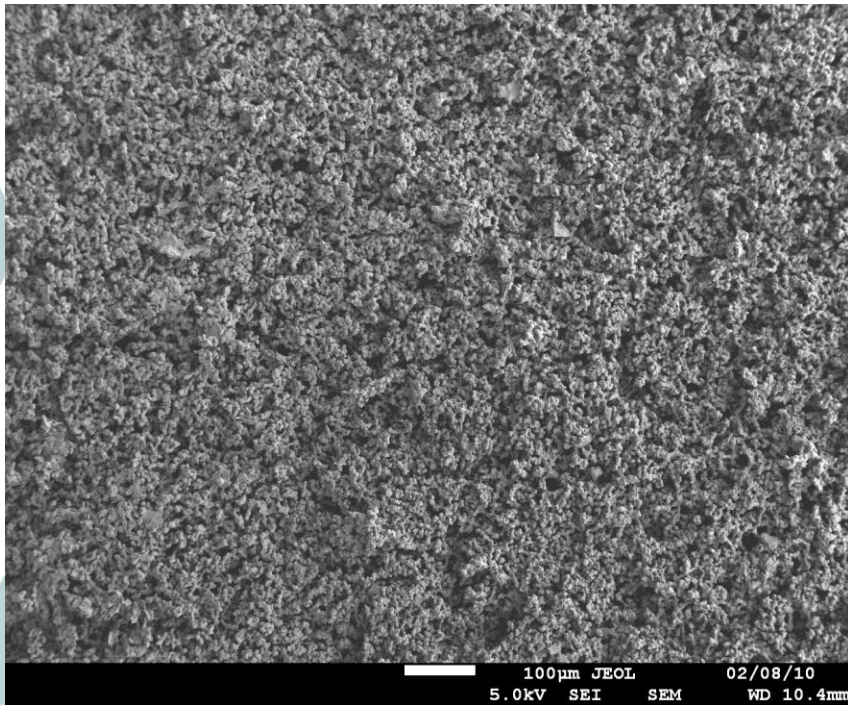
**The spherocolloids** are long polymeric chains, which combined form a mechanically strong structure with the internal surface size up to  $500 \text{ m}^2/\text{g}$ .

There are active ion-exchange groups on the globules' surface.

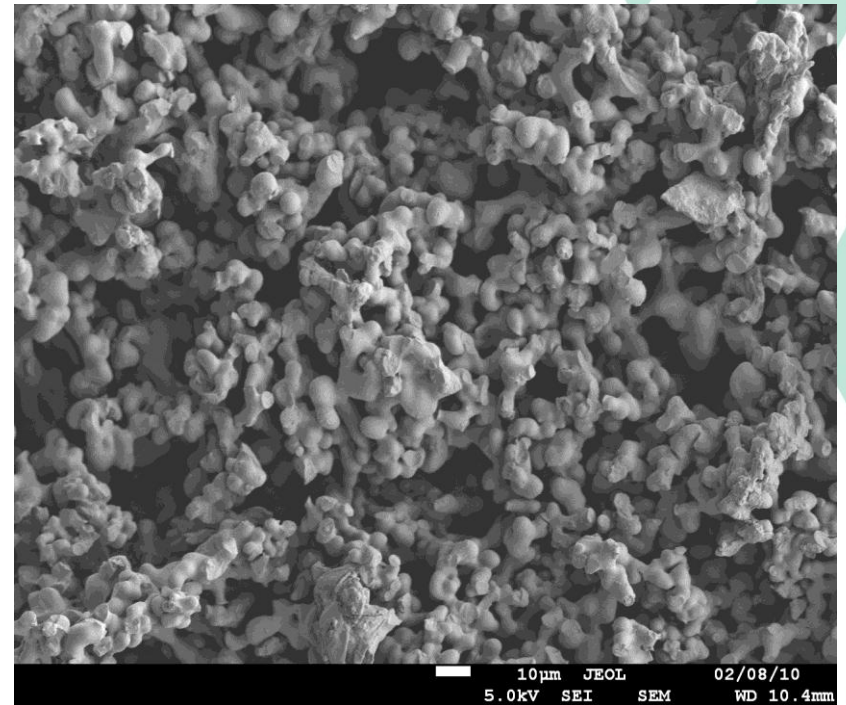
Photos of ARAGON made by an electronic microscope

# ARAGON Material Photos

100  $\mu\text{m}$

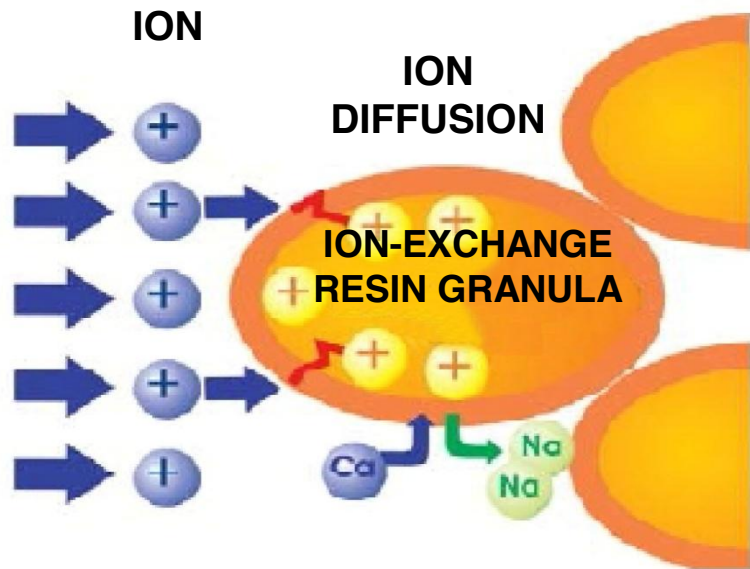


10  $\mu\text{m}$

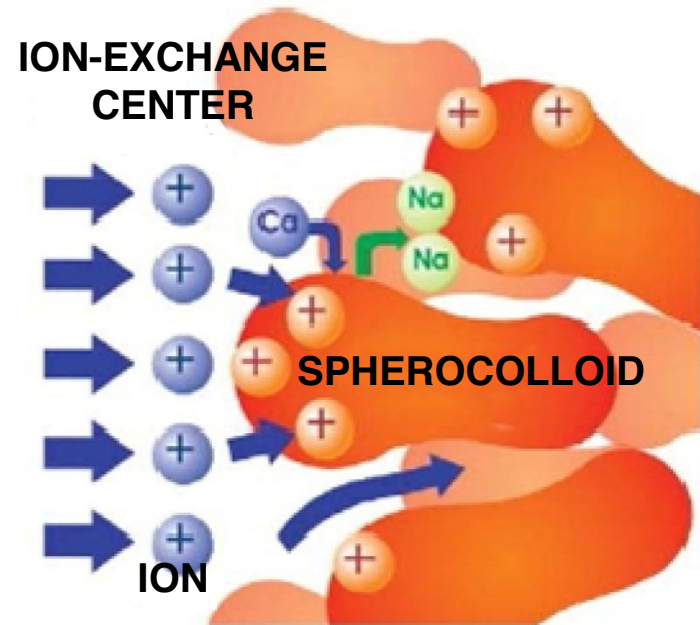




# How SGS-Polymers work



ION-EXCHANGE RESIN



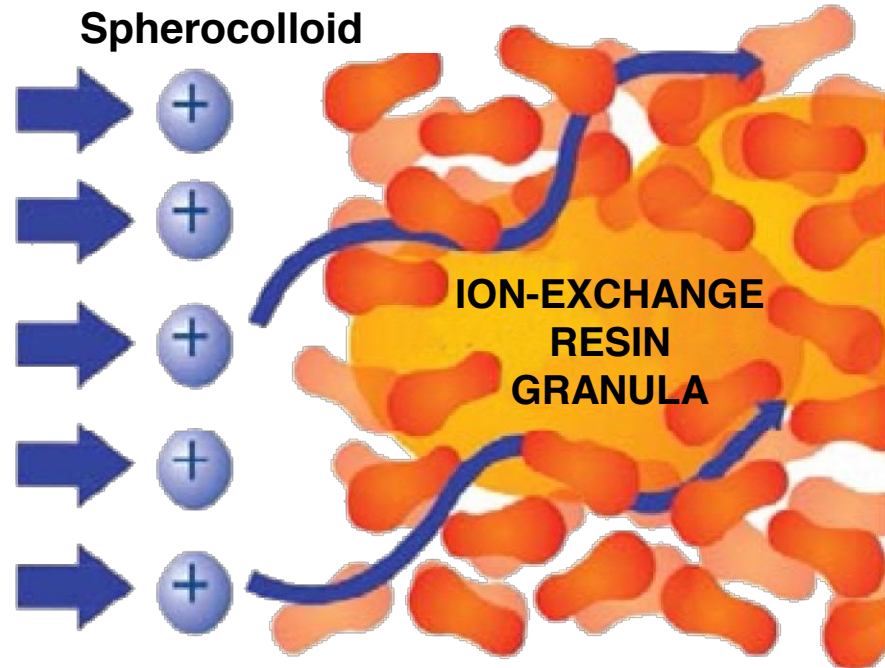
SGS-POLYMER

**The mass transfer** is achieved by solutions passing through the polymer spherocolloids, rather than by diffusion process as there is in ordinary ion exchangers.

**The transfer rate** is subject to film kinetics laws. Therefore the efficiency of SGS ion exchange depends on the rate of solution replenishment in spherocolloids, i.e. the exchange rate will grow as solution throughput rate increases.



# ARAGON-2



The inclusion of ion-exchange resin granulae in the polymer structure enables to increase the material's ion-exchanging capacity **twelve-fifteenfold**.

The resin particles are confined due to mechanical and electrokinetic bonds.



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## Removal of Insoluble Particles by Aragon BIO Cartridge

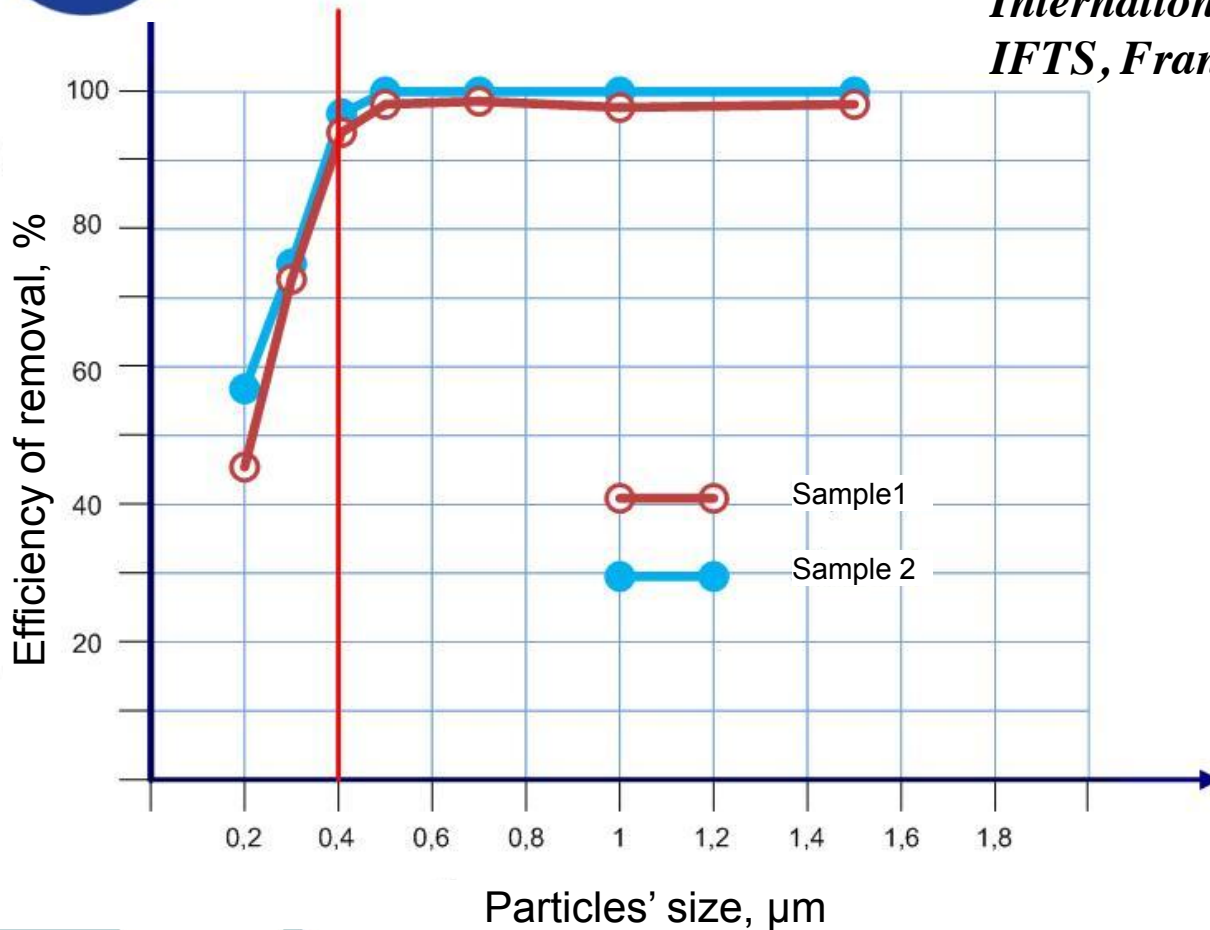
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Saint Petersburg, 2014



# Efficiency of Insoluble Particles' Removal

*International Filter Testing Services  
IFTS, France*



**Efficient removal** of suspended particles of a preset sieving threshold, including bacteria and viruses.



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Removal of Contaminants.  
**ARAGON Ion-Exchange Properties.**

*The V.G. Khlopin Radium Institute*

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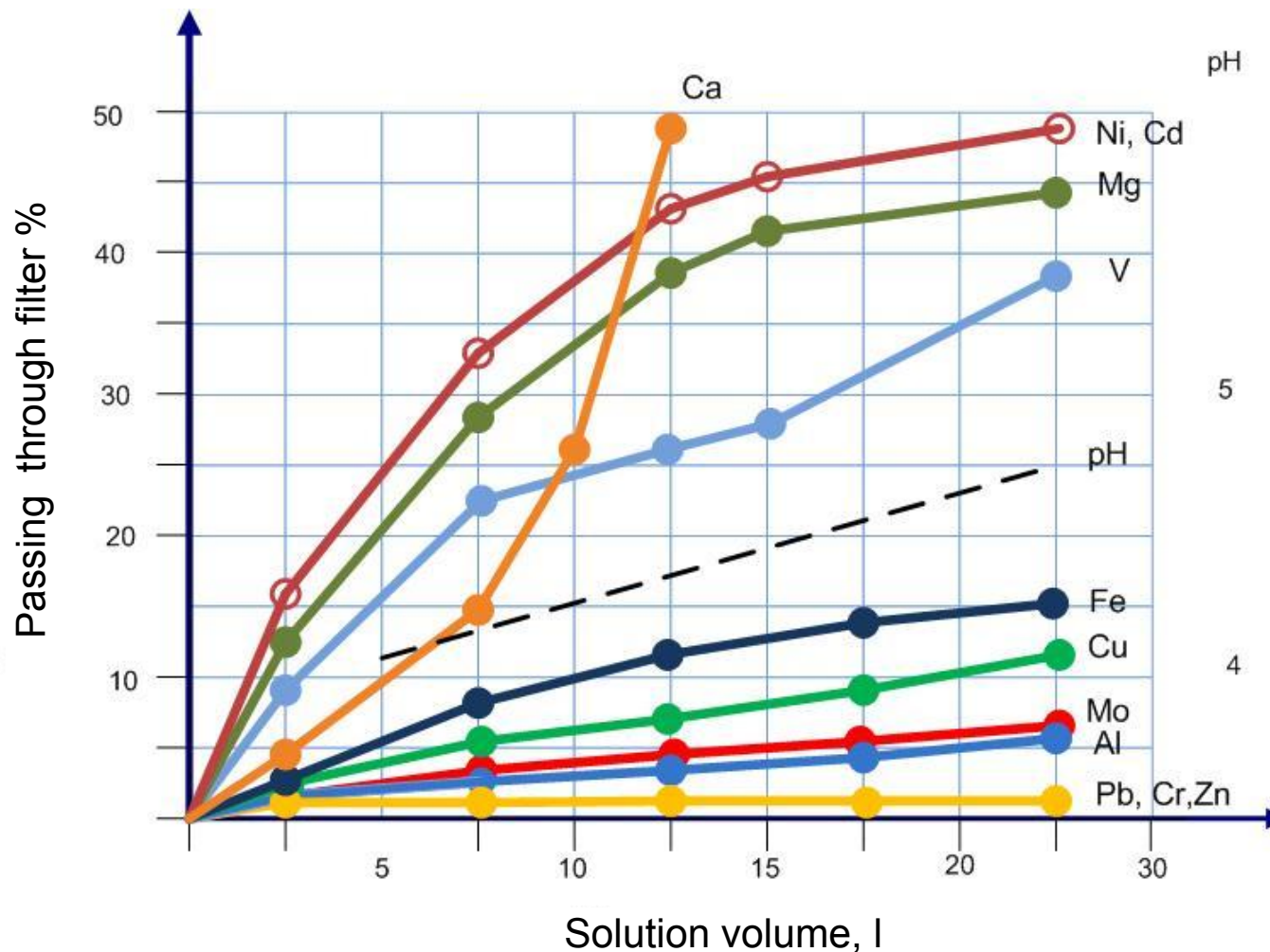
Saint Petersburg, 2014





# Metals removal efficiency, including radioactive ones

Elements' concentrations in the test solution, mg/l



pH

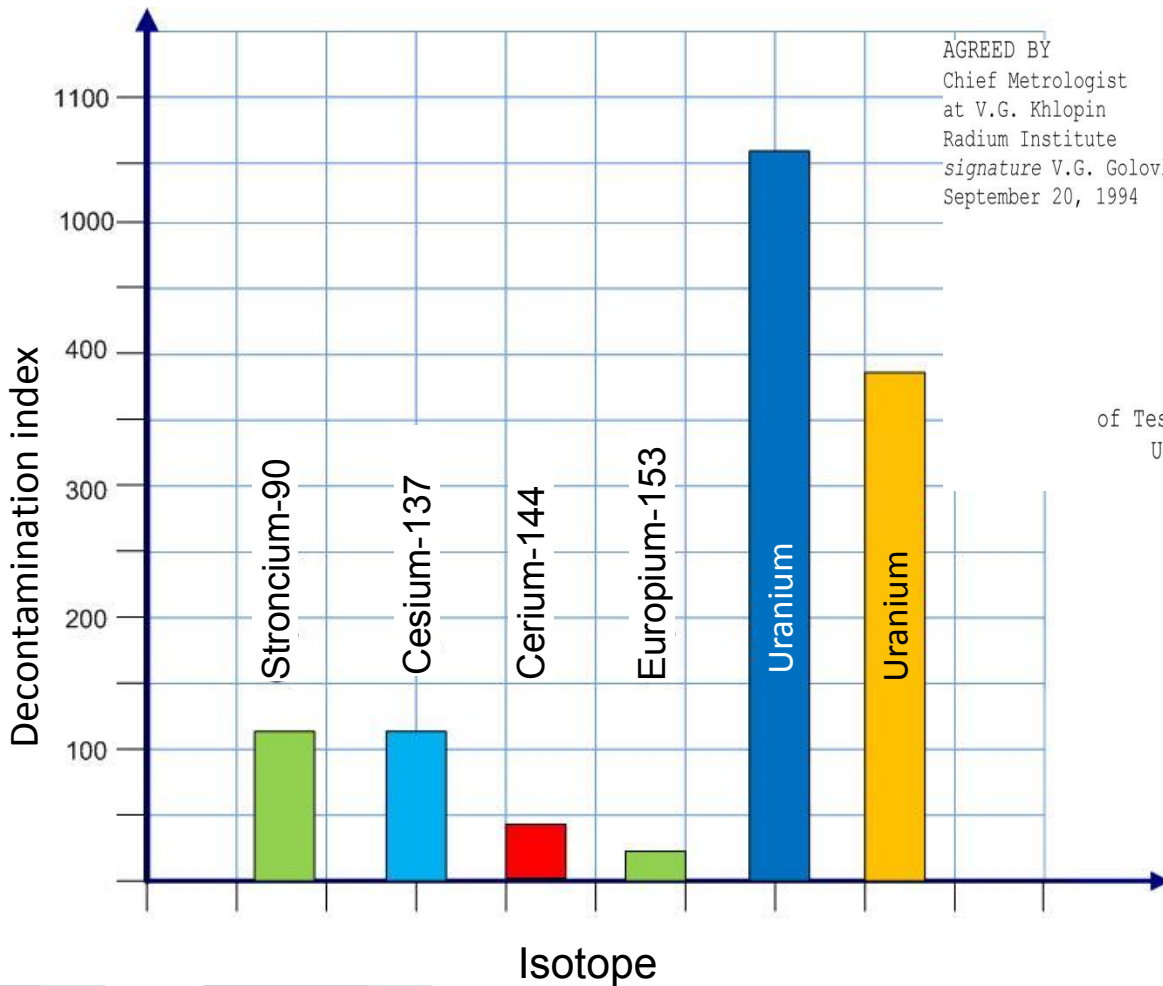
5

4

Ca	4.7	-
Mg	3.3	-
Fe	2.7	10 MAC
Al	1.4	3 MAC
Mo	2.8	10 MAC
Pb	0.9	30 MAC
V	0.5	10 MAC
Ni	0.6	6 MAC
Zn	0.3	MAC
Cd	0.2	200 MAC
Cu	0.2	MAC
Cr	0.1	MAC



# Treatment Efficiency of Water Contaminated by Radioactive Elements



AGREED BY  
Chief Metrologist  
at V.G. Khlopin  
Radium Institute  
signature V.G. Golovlev  
September 20, 1994

**Seal:**  
Research & Production  
Association \*V.G. Khlopin  
Radium Institute

APPROVED BY  
Deputy Director General  
of the Research & Production Association  
"V.G. Khlopin Radium Institute"  
signature Ye. B. Anderson  
September 20, 1994

CERTIFICATE

of Testing of Space-Globular Structure (SGS) Sorbents  
Used in the Treatment of Waters Contaminated  
with Radioactive Substances



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## Cartridges' ARAGON Test Data

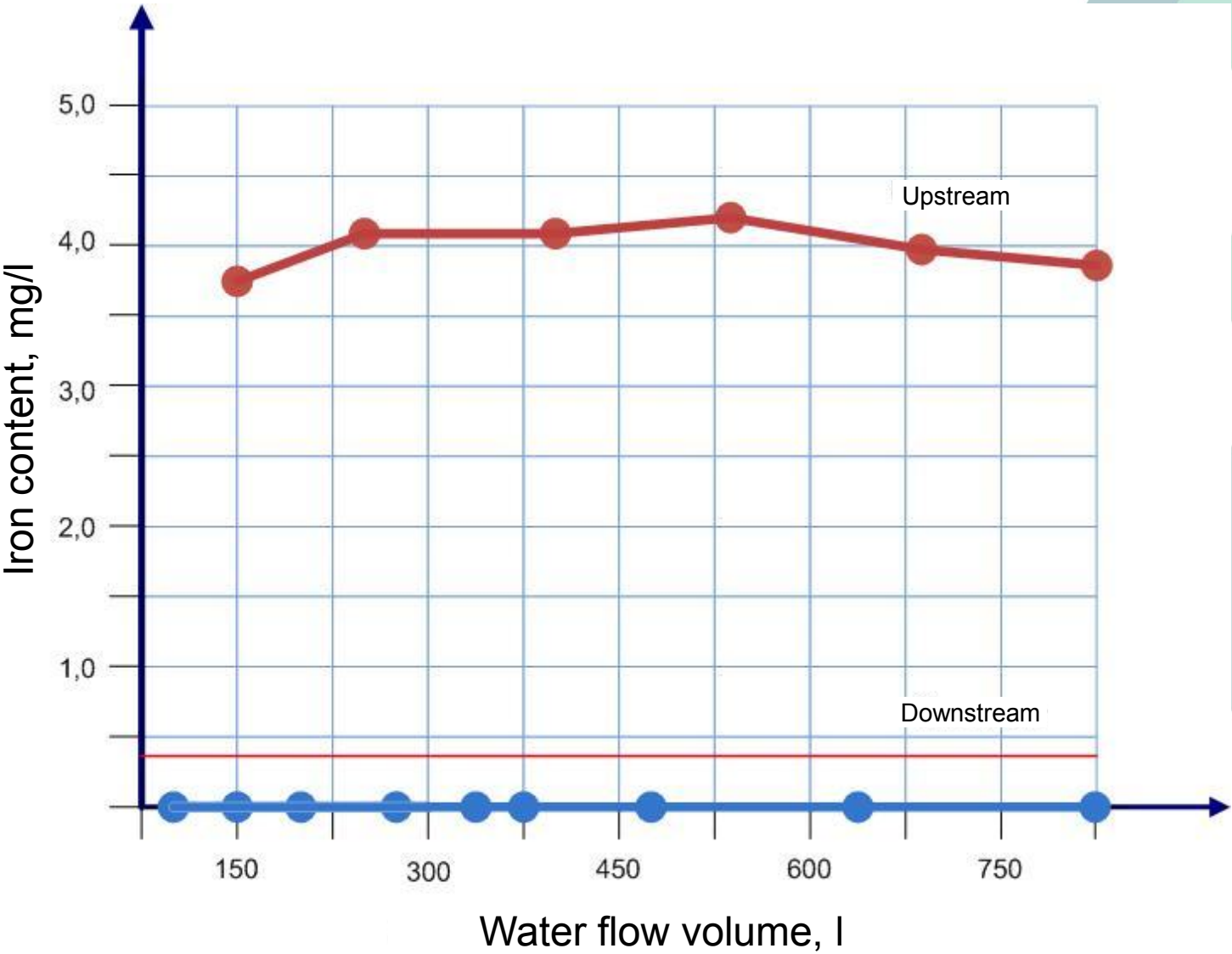
Institute of Filtration and Separation Techniques  
*IFTS, France*

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Saint Petersburg, 2014



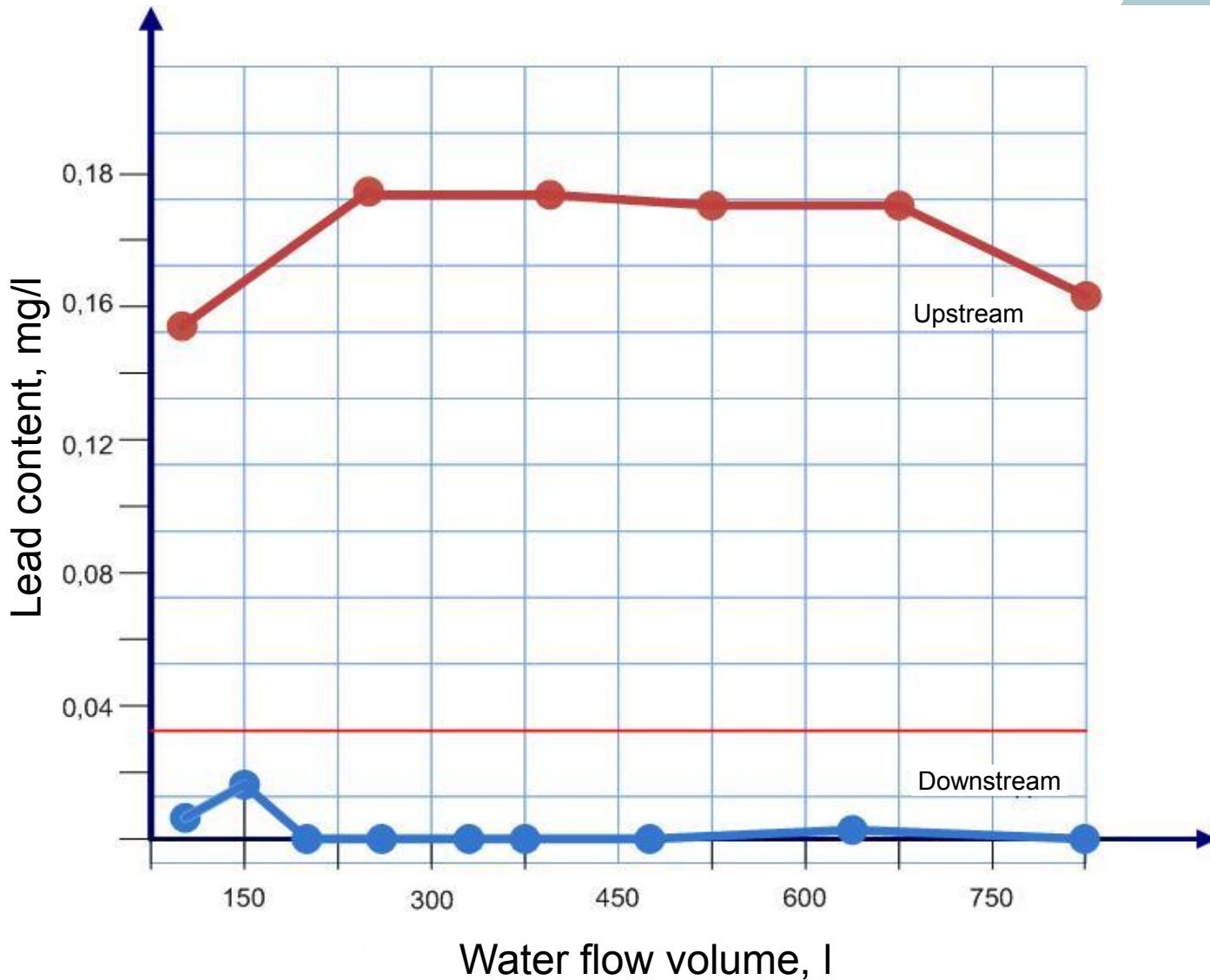
# Iron Removal Efficiency





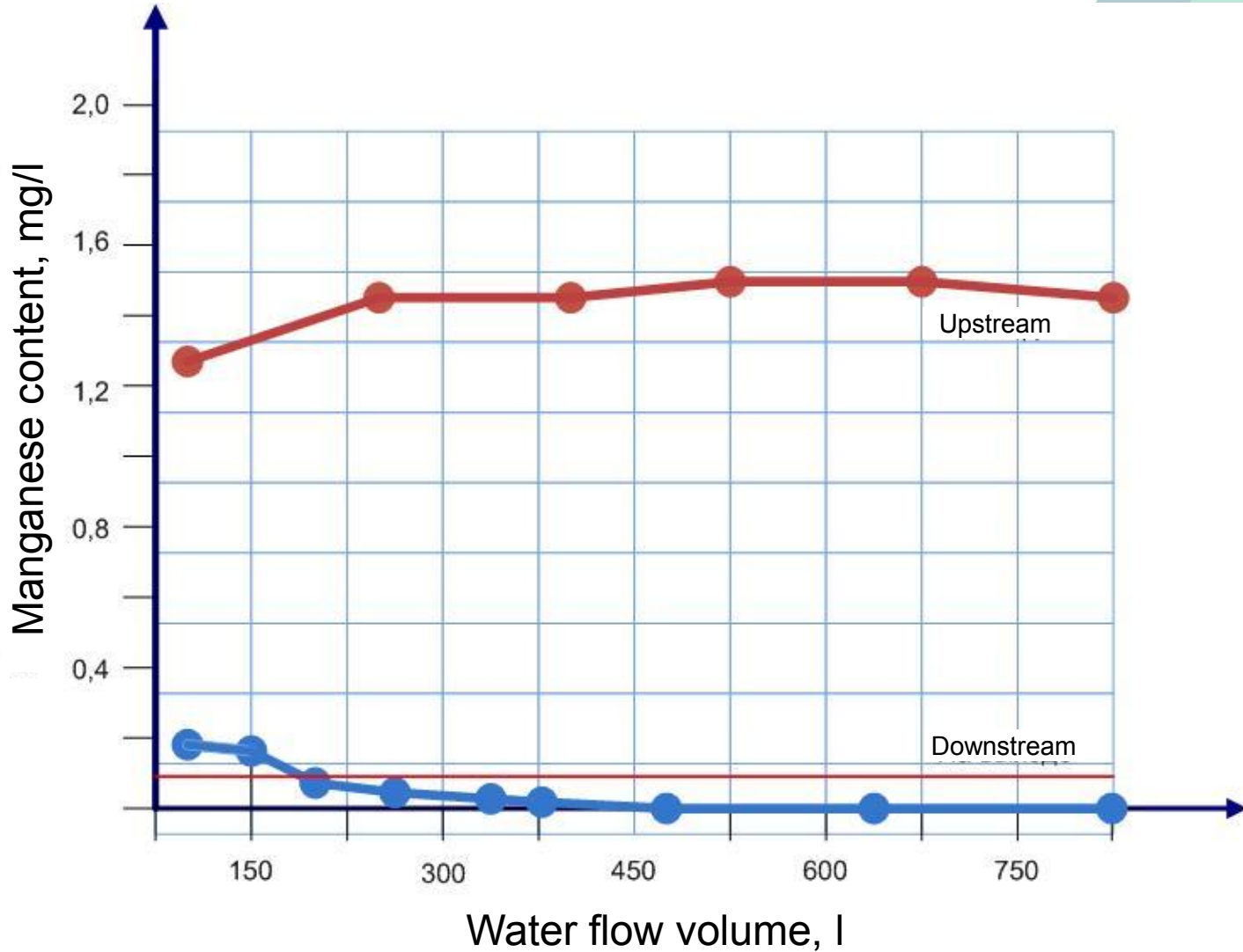


# Lead Removal Efficiency



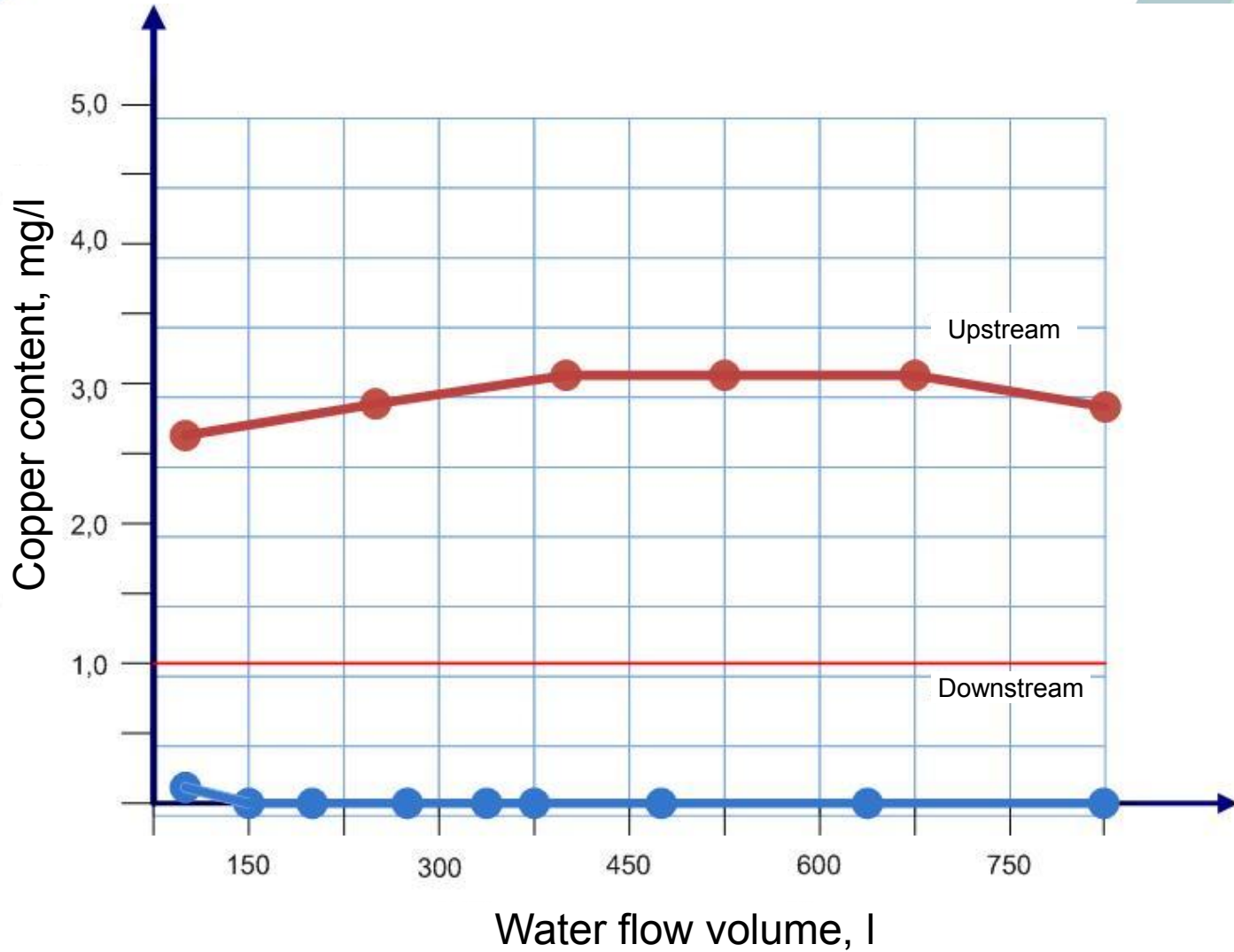


# Manganese Removal Efficiency





# Copper Removal Efficiency





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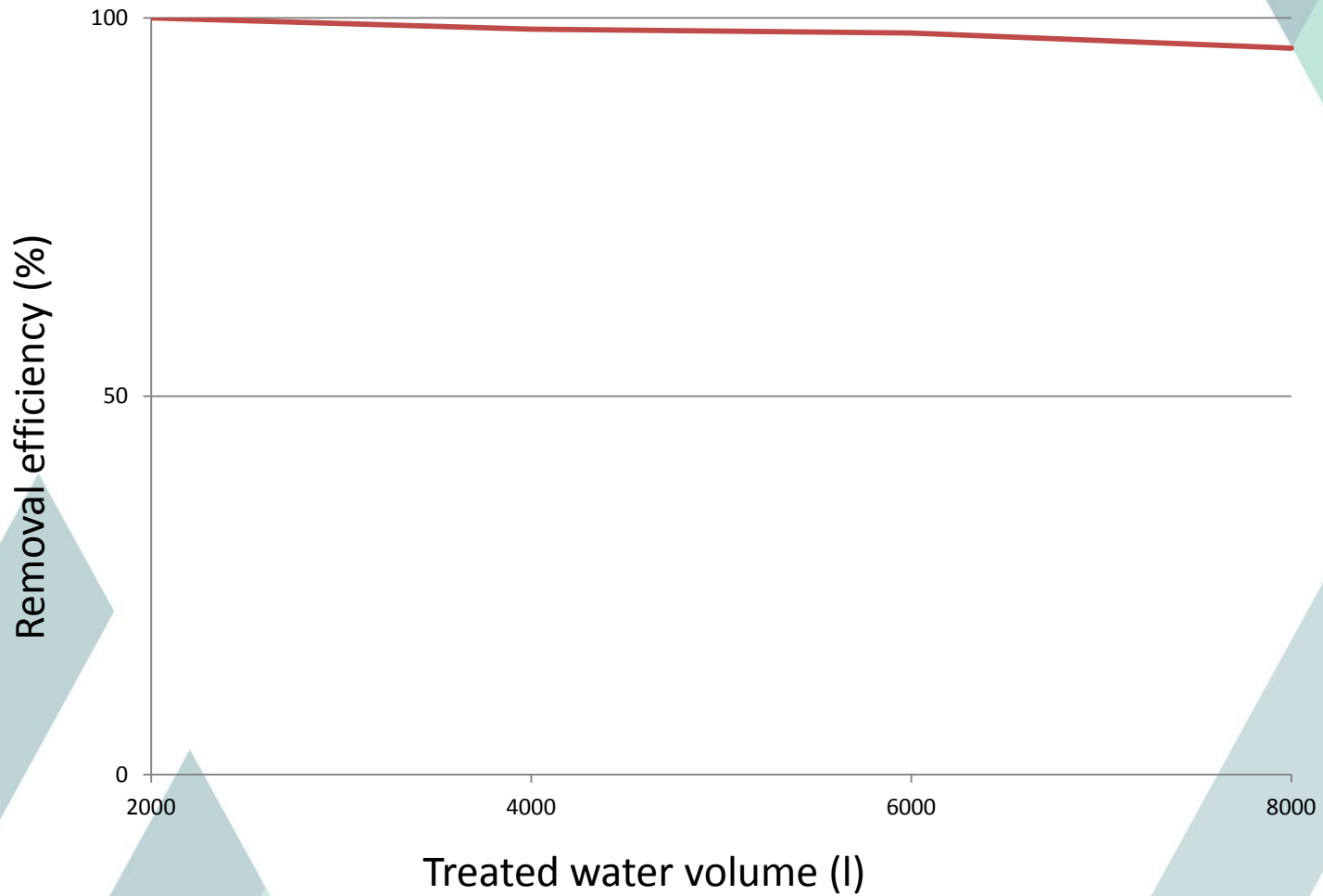
Removal of Contaminants.  
**ARAGON Sorption Properties.**

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Saint Petersburg, 2014

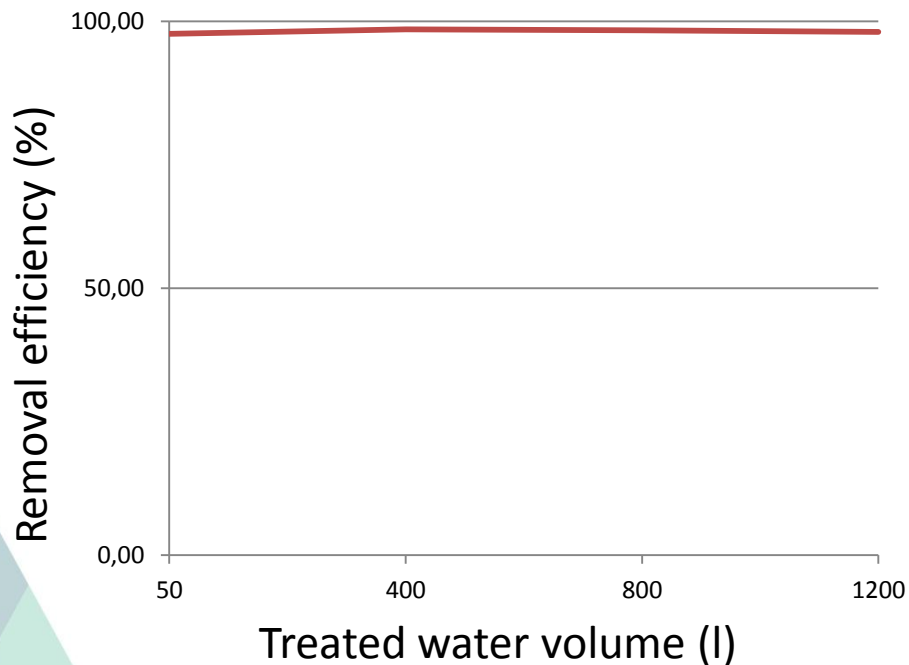


# Free Chlorine Removal



# Pesticides Removal Efficiency (through the example of simazin)

Treated water volume (l)	Inlet concentration, mg/l	Outlet concentration, mg/l	Removal efficiency (%)
50	1,1	0,01	97,62
400	1,0	0,015	98,50
800	1,2	0,02	98,33
1200	1,0	0,02	98,00





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## Quasi-Softening

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Saint Petersburg, 2014

# Discovery of Quasi-Softening



Without filter



With filter

The practice of continuous exploitation of filters with ARAGON in different Russian regions with hard water showed the unexpected effect. Even when a filter ion-exchange capacity expires, the treated water does not scale and even destroys the appeared scum.

# Quasi-Softening

## The invention patent No. 2261843



Aragonite

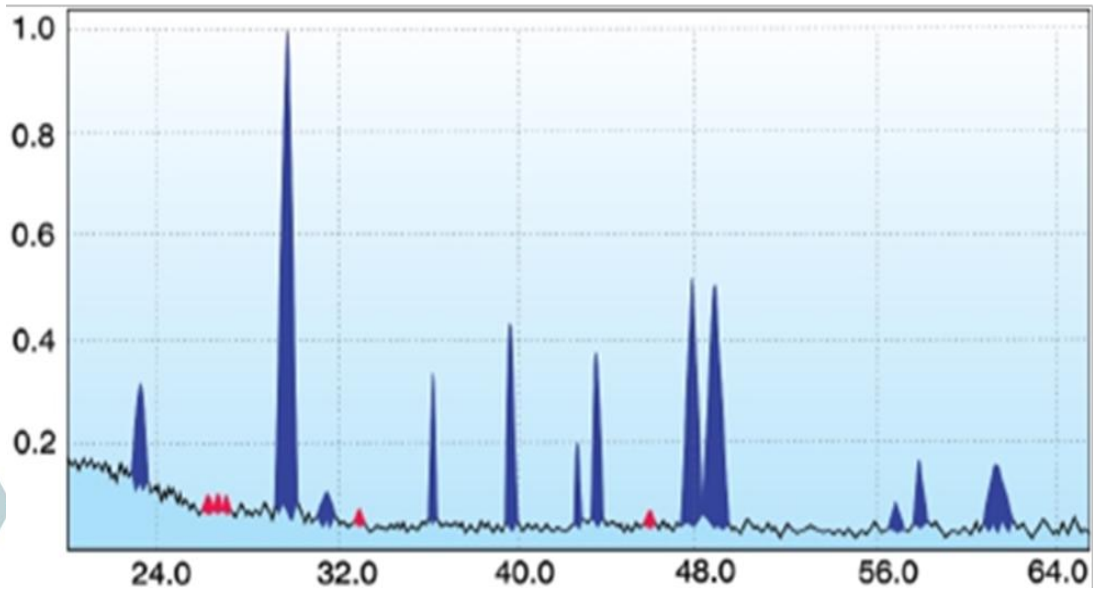


Calcspars

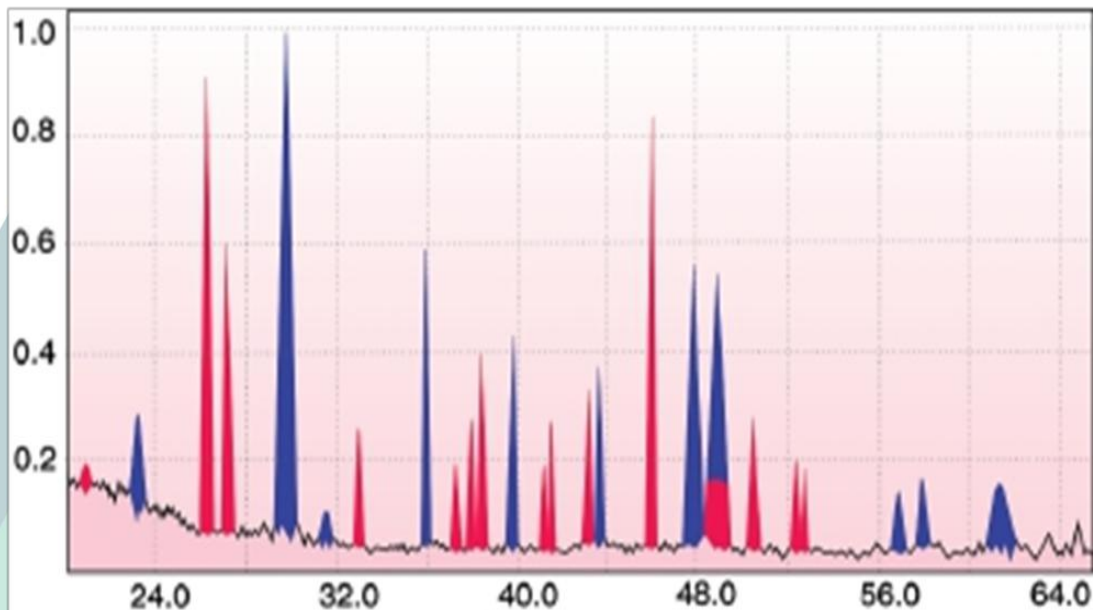
The hardness salts exist in water as metastable structures (clusters). As clusters move in channels between the spherocolloids the pressure increases and causes a shift of chemical balance. That is why, the chemical balance shifts towards dissolution of carbon dioxide contained in the water. Conditions for clusters recrystallization from Calcspars to aragonite are created. Downstream pressure grows and then drops rapidly. Carbon dioxide releases and pH increases; chemical balance shifts towards carbonates formation. The solution is oversaturated with the carbonates and enlarged aragonite seeds are formed. As more heated as less the aragonite solubility.



# Water Spectral Structure Change



Ordinary hard water:  
5% aragonite  
95% calcspar

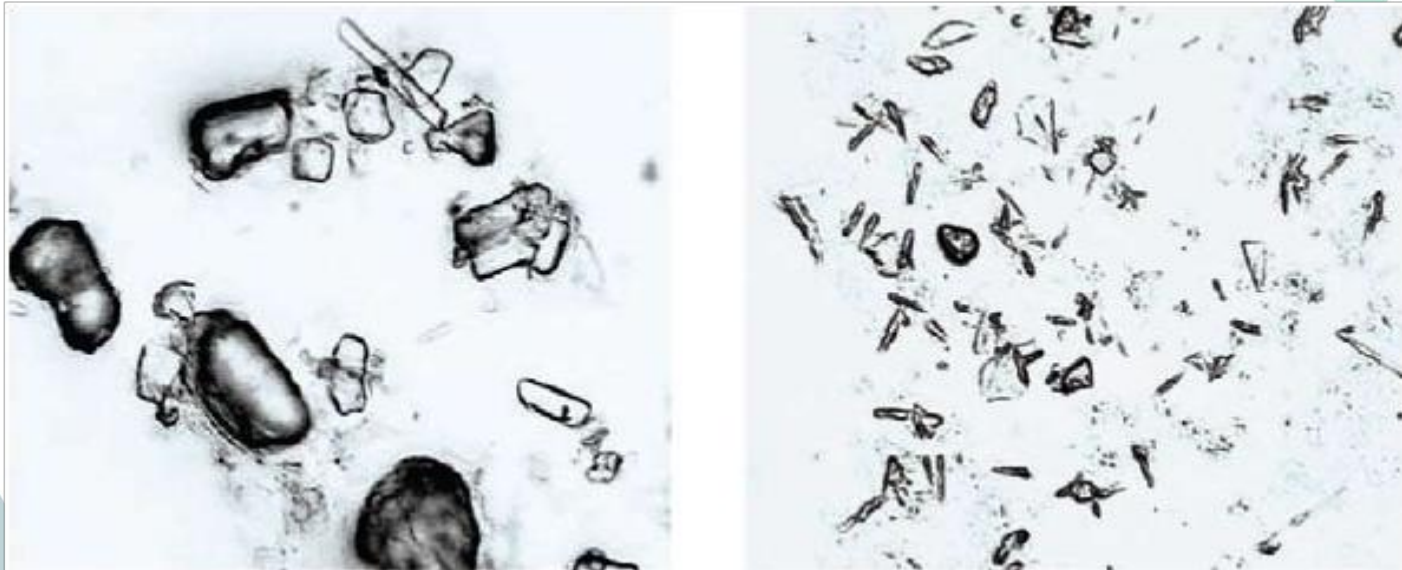


Treated water:  
40% aragonite  
60% Calcspar



# ARAGON is as a mechanism of kidney stone disease prevention

The S.M. Kirov Military  
Medical Academy



Researches conducted at St. Petersburg Military Medical Academy have shown that when people drink hard water passing-through ARAGON there are less crystals causing lithiasis in people's organisms. The photos of white rats' urine sediment show the sizes difference. The aragonite form of hardness salts contributes to better calcium availability thus lowering the load on kidneys.



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## Viruses and Bacteria Removal By Aragon BIO

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Saint Petersburg, 2014



**AHLSTROM**

**Nowadays in the world there are only two Companies that can produce cartridges which are able to delete all viruses and bacteria from water – GEYSER (Russia) and AHLSTROM (USA).**

**Geyser Group of Companies produces the cartridges based on SGS-polymers, and the American company uses nanoaluminium sorbing agent.**



# Method of Viruses Removal from Water. Invention Patent

РОССИЙСКАЯ ФЕДЕРАЦИЯ



**ПАТЕНТ**

НА ИЗОБРЕТЕНИЕ

№ 2506232

**СПОСОБ ИНАКТИВАЦИИ ВИРУСОВ В ВОДНЫХ СРЕДАХ**

Патентообладатель(и): **ОБЩЕСТВО С ОГРАНИЧЕННОЙ ОТВЕТСТВЕННОСТЬЮ "АКВАТОРИЯ" (RU)**

Автор(ы): **Фридкин Александр Михайлович (RU), Гребенщиков Николай Романович (RU), Сафин Валерий Мансурович (RU)**

Заявка № 2012117611

Приоритет изобретения **23 апреля 2012 г.**

Зарегистрировано в Государственном реестре изобретений Российской Федерации **10 февраля 2014 г.**

Срок действия патента истекает **23 апреля 2032 г.**

Руководитель Федеральной службы  
по интеллектуальной собственности

Б.П. Симонов



РОССИЙСКАЯ ФЕДЕРАЦИЯ



ФЕДЕРАЛЬНАЯ СЛУЖБА  
ПО ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ

(12) **ФОРМУЛА ИЗОБРЕТЕНИЯ К ПАТЕНТУ РОССИЙСКОЙ ФЕДЕРАЦИИ**

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27.08.2010. JP 2005254118 A, 22.09.2005. WO  
02/083571 A1, 24.10.2002. EP 0094226 A2,  
16.11.1983. JP 3239239 B2, 17.12.2001.

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**B01J 20/28** (2006.01)

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(72) Автор(ы):

**Фридкин Александр Михайлович (RU),  
Гребенщиков Николай Романович (RU),  
Сафин Валерий Мансурович (RU)**

(73) Патентообладатель(и):

**ОБЩЕСТВО С ОГРАНИЧЕННОЙ  
ОТВЕТСТВЕННОСТЬЮ "АКВАТОРИЯ"  
(RU)**

(54) **СПОСОБ ИНАКТИВАЦИИ ВИРУСОВ В ВОДНЫХ СРЕДАХ**

(57) Формула изобретения

1. Способ инактивации вирусов в водных средах, включающий прохождение под давлением жидкости через зоны с сорбционными материалами, отличающийся тем, что в качестве сорбционного материала по крайней мере одной из зон используют пористый фильтрующий элемент на основе смол, полученных конденсацией альдегидов с ароматическими фенолами или аминами, обладающий следующими характеристиками: отношение абсолютного значения дзета потенциала пористого фильтрующего элемента к значению эффективного радиуса канала протекания жидкости составляет не менее  $10^6$  В/м.

2. Способ по п.1, отличающийся тем, что в качестве сорбционного материала по крайней мере одной из зон используют пористый фильтрующий элемент на основе смолы, полученной конденсацией формальдегида с резорцином.

3. Способ по п.1, отличающийся тем, что в качестве сорбционного материала по крайней мере одной из зон используют пористый фильтрующий элемент на основе смол, полученных конденсацией формальдегида с меламином.

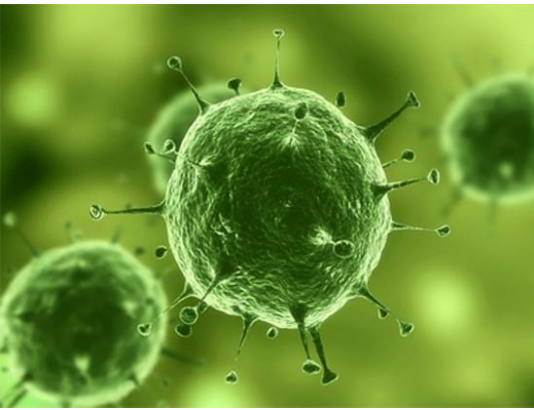
4. Способ по п.1, отличающийся тем, что пористый фильтрующий элемент содержит намывной слой из сорбционного материала, характеризующегося



# Classification of Viruses

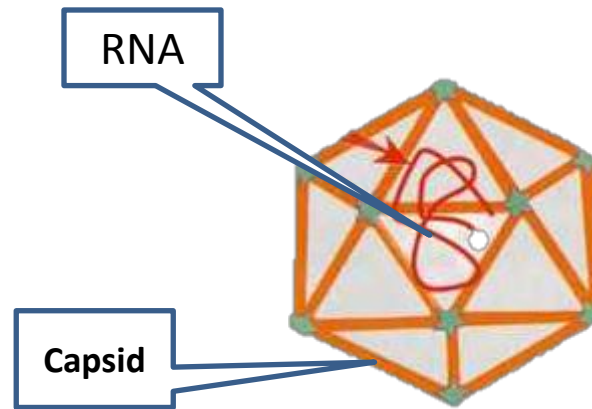
Class of Viruses	Size ( $\mu\text{m}$ )	Share (%)	Diseases
Hepatitis A	27 – 32	3	Hepatitis
Norovirus	27 - 40	82	Intestinal influenza and acute enteric infection
Rotavirus	60 - 70	5	Rotaviral enteritis
Entero- and astroviruses	27 - 30	5	Poliomyelitis, etc.
Adenoviruses	70 - 90	5	Catarrhs of the upper respiratory tract , conjunctivitis, atypical pneumonia, etc.





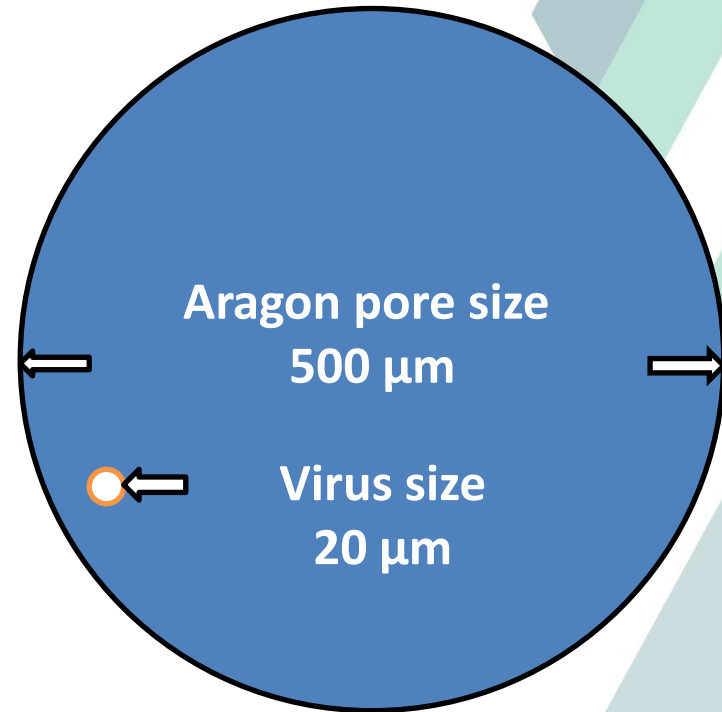
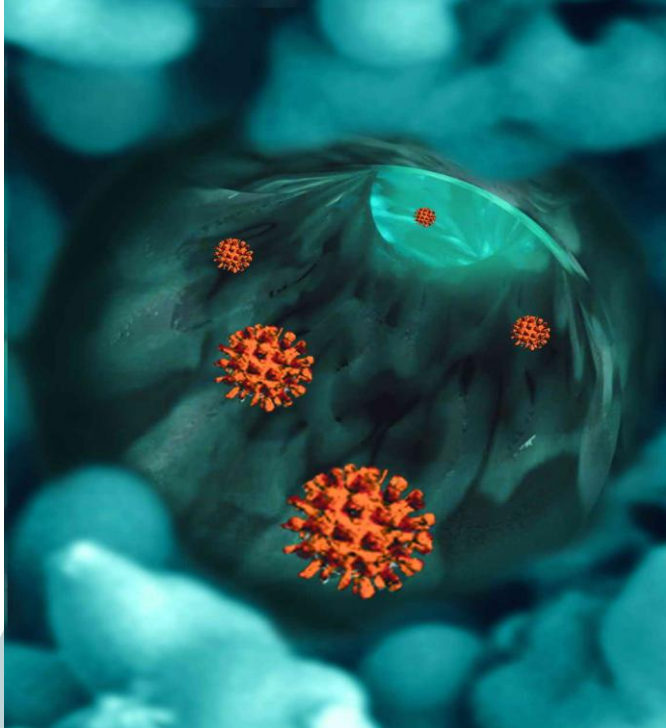
## The enemy without taste and smell

The virus cannot reproduce itself independently. In fact, it is some biological organization the main purpose of which is to find an object to reproduce into.



Most of the viruses have an envelope (capsid) protecting RNA in which the division process is preprogrammed. To neutralize a virus it is enough to destroy the capsid or damage RNA.


# Viruses Removal Mechanism

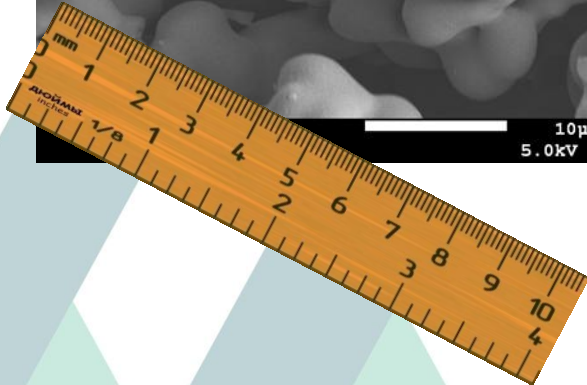
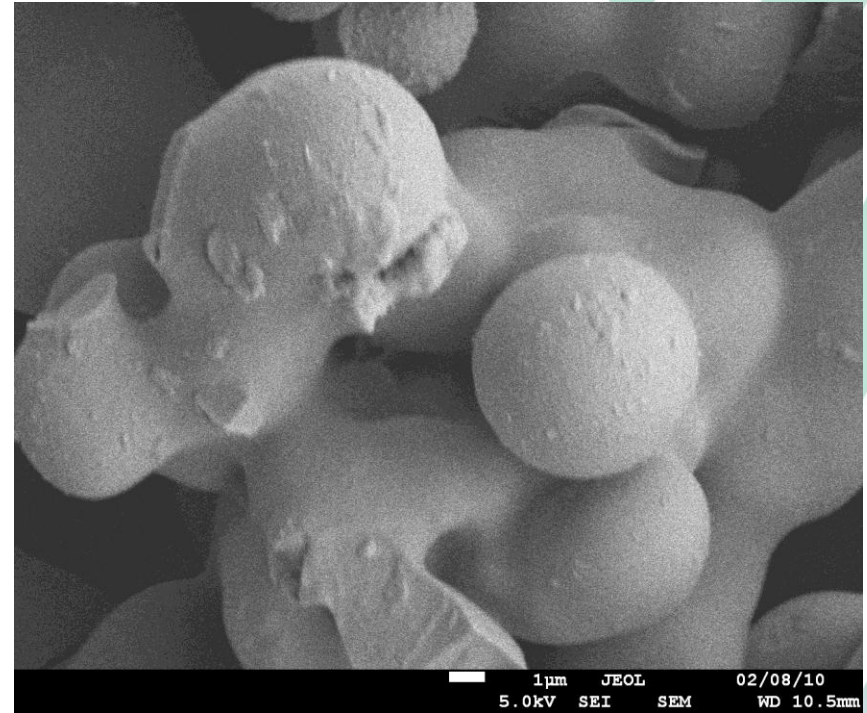
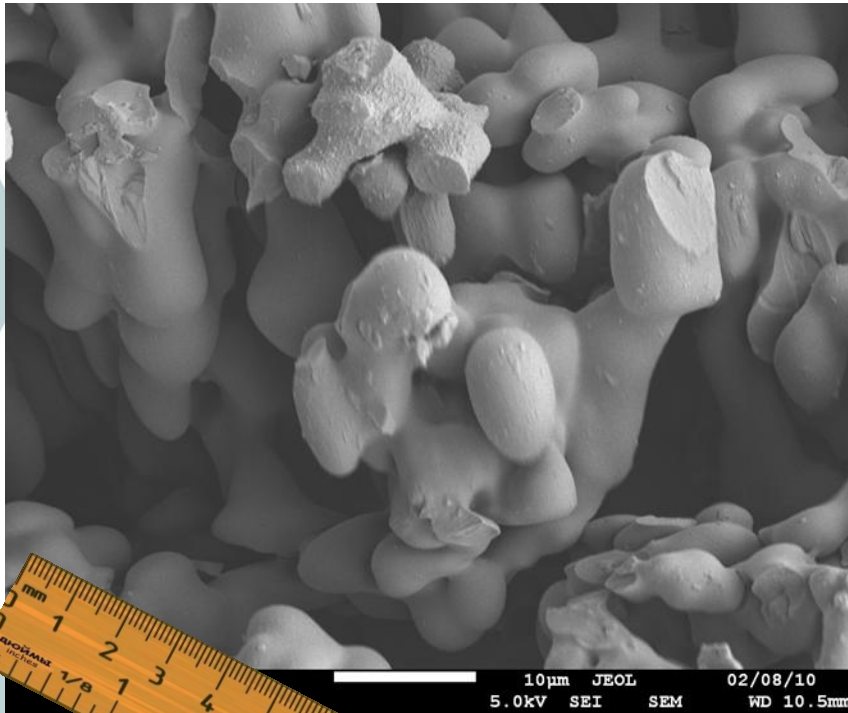


It has been established that Aragon pores are determined to have intensive surface potential that is opposite to the viruses' charges. That is why, when water with viruses passes through the Aragon pores the electric interaction between the material and viruses appears. This electric interaction is the same as one between opposite charges.

# ARAGON Photos Made By an Electronic Microscope

 10  $\mu\text{m}$

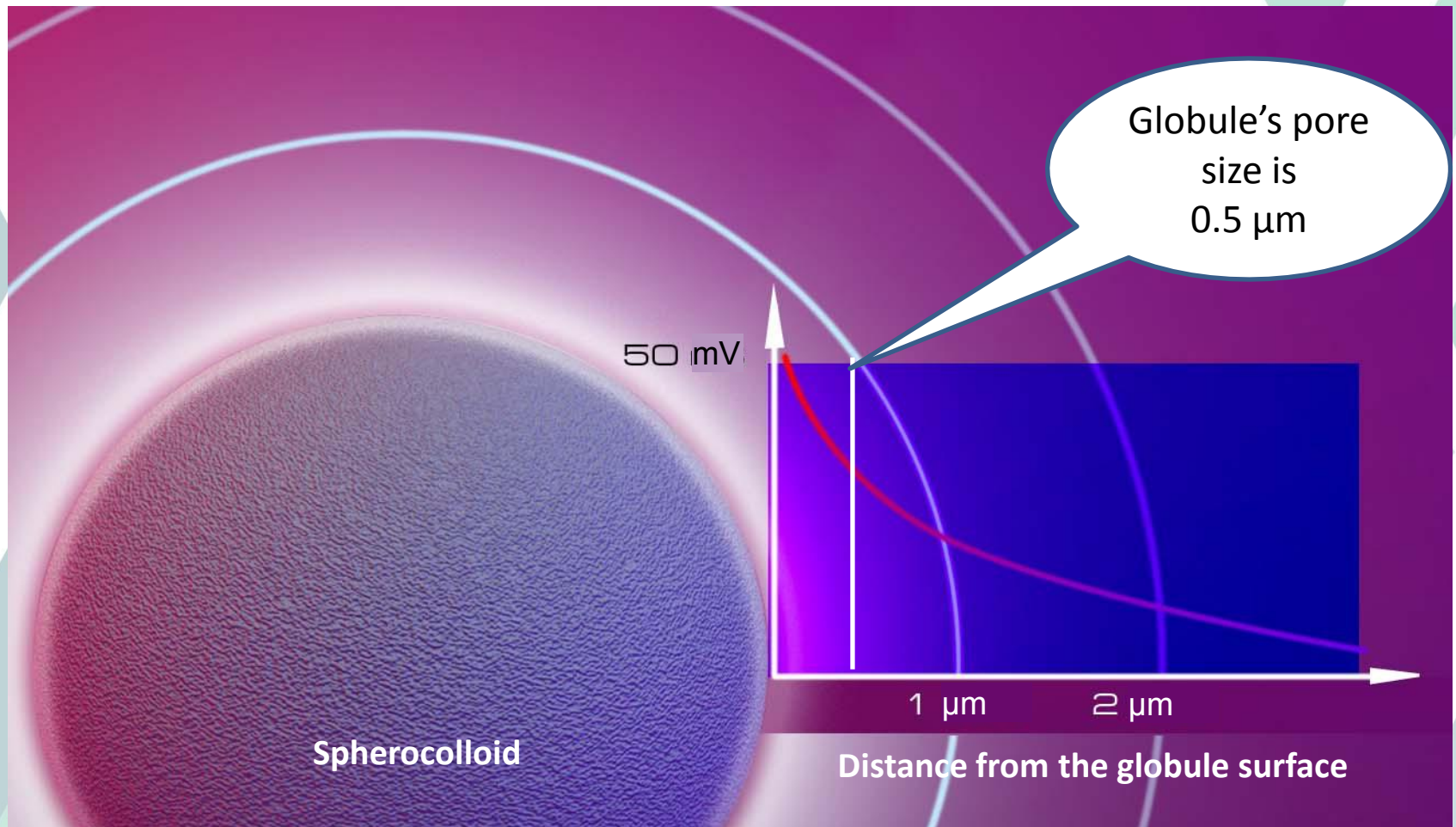
 1  $\mu\text{m}$





# The Electric Field of a Globule

The surface of a globule has negative charge and forms strong magnetic field developed around it. That covers the entire pore fully.

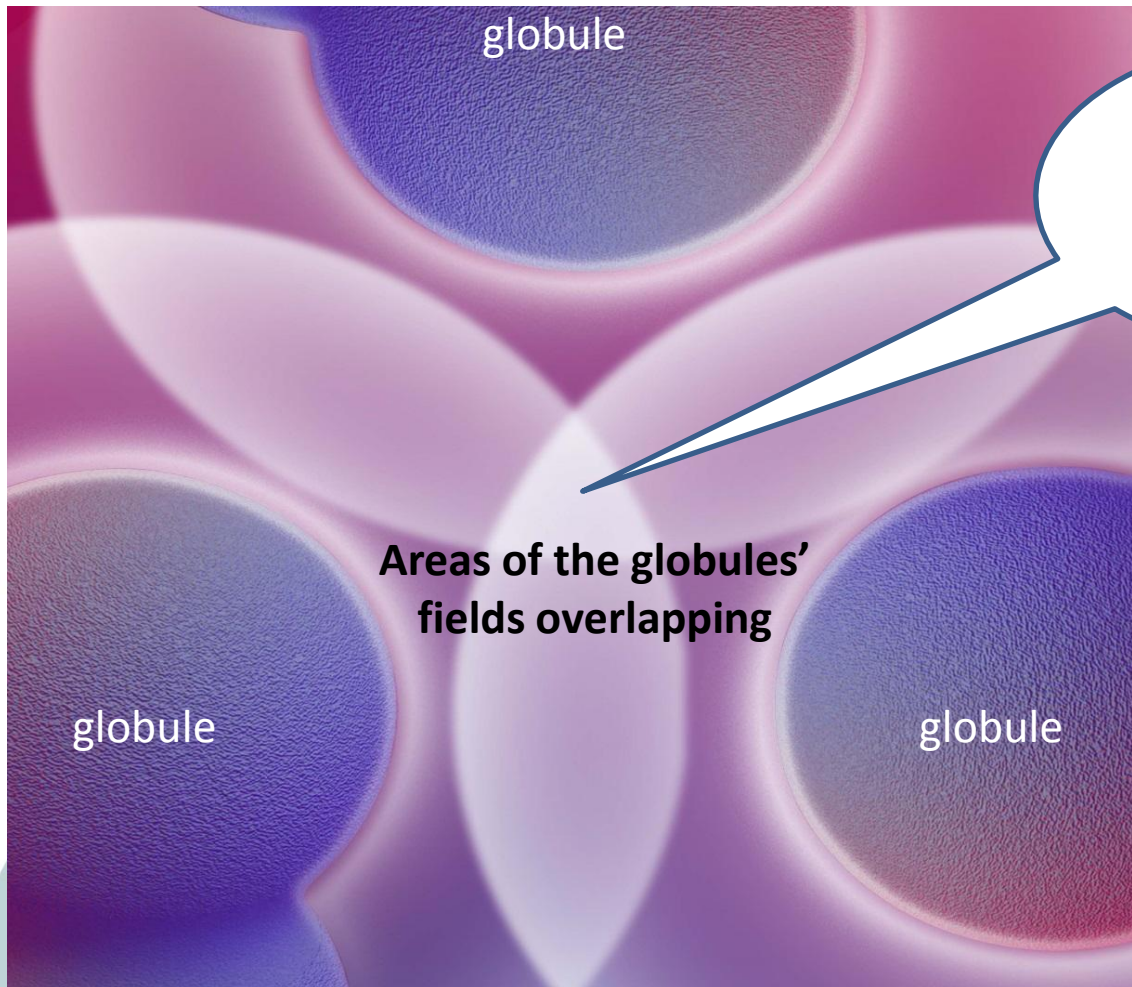




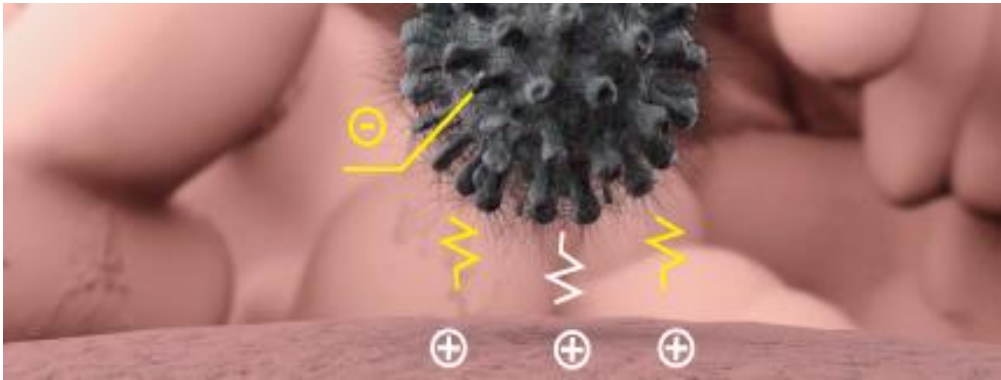
# The Electric Field Inside the Pore



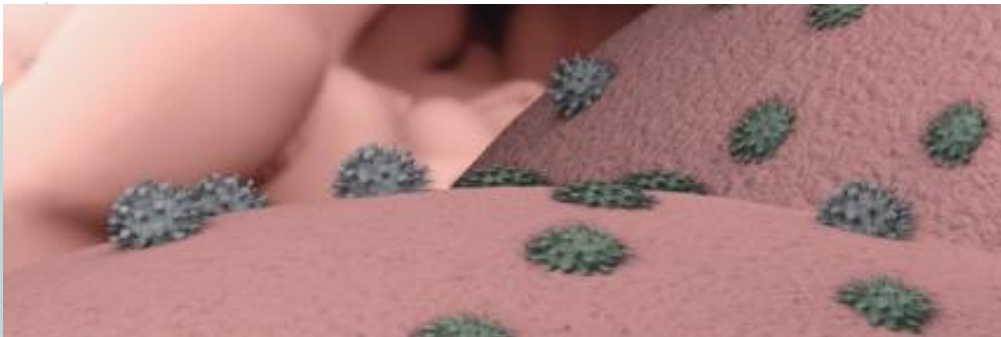
As a result of overlapping of individual globules' fields, high gradient electric field of high intensity is formed inside the pore.



# Electrokinetic mechanism of impact on viruses

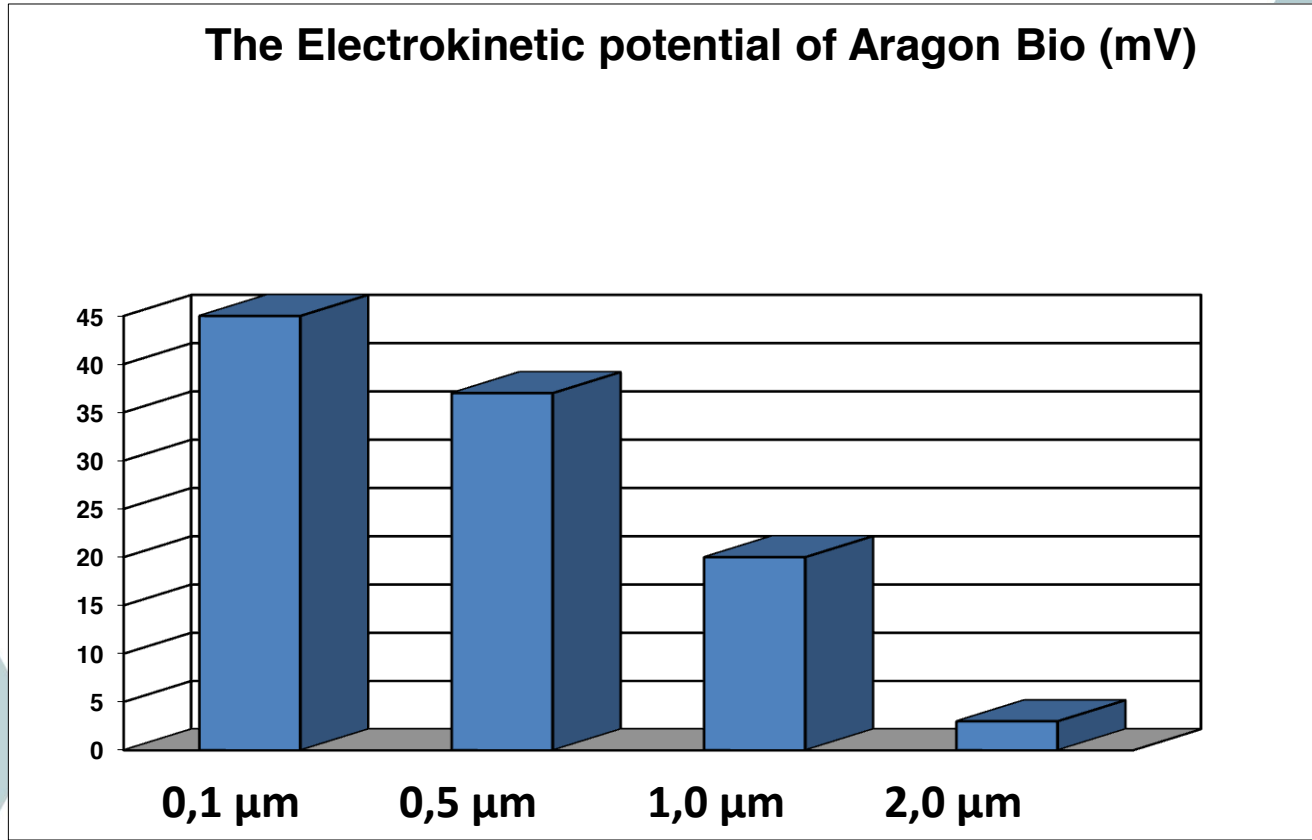


The electric field destroys the external protective cover of a virus.



Without the envelope a virus dies fast

# The Results of Filtering Materials $\zeta$ -Potential Dimensions



The  $\zeta$ -potential decreases as more as a pore size increases (from 0.5 to 2  $\mu\text{m}$ ). Thus, we can vary globules relative position and size and endue the polymer with the power to remove bacteria and viruses effectively.

# The Aragon BIO Ability to Retain Viruses and Bacteria Tested & Confirmed



The V.G. Khlopin  
Radium Institute



The S.M. Kirov Military  
Medical Academy  
2008



The Research Institute  
of Epidemiology  
and Microbiology named  
after L. Pasteur  
2007 – 2010



The Research Institute  
of Human Ecology and  
Environmental Health named  
after A.N. Sysin  
2011



The Research Institute  
of Influenza  
2011



Università di Ferrara  
2012 г.



Institut Pasteur de Lille  
2014 г.





# The Opinion of the Research Institute of Human Ecology and Environmental Health Named After A.N. Sysin (Russia)



МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ  
И СОЦИАЛЬНОГО РАЗВИТИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ



ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ  
«НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ЭКОЛОГИИ ЧЕЛОВЕКА  
И ГИГИЕНЫ ОКРУЖАЮЩЕЙ СРЕДЫ ИМ. А.Н.СЫСИНА»

Исх. №: \_\_\_\_\_ от \_\_\_\_\_  
на №: \_\_\_\_\_

Российская Федерация, 119992, Москва, Подпорожская ул. 10/15, стр.1  
Телефон: 8 (499) 246 5024, Факс: 8 (499) 245 0314, E-mail: ysusn@otomsk.ru



УТВЕРЖДАЮ  
Директор ФГБУ «НИИ ЭЧ и ГЭС им. А.Н.Сысина»  
Минздравоохранения России  
Ю.А. Рахманин  
«\_\_\_» \_\_\_\_\_ 2011 г.

## ЗАКЛЮЧЕНИЕ

по результатам гигиенической оценки эффективности очистки воды от химических и микробных загрязнений воды ионообменными картриджами АРАГОН-БИО производства ООО «Акватория»

Гигиеническая оценка эффективности работы ионообменных фильтров АРАГОН-БИО выполнена в комплексных исследованиях, проведенных на базе ФГБУ НИИ Экологии человека и гигиены окружающей среды им. А.Н.Сысина Минздравоохранения России и ФГУН «Санкт-Петербургский НИИ Эпидемиологии и микробиологии им. Пастера» Роспотребнадзора в соответствии с требованиями ГОСТА Р 51871 «Устройства водоочистные. Общие требования к эффективности и методы ее определения».

На основании проведенных исследований были сделаны следующие выводы:

1. Испытанные ионообменные картриджи АРАГОН-БИО показали 100% эффективность очистки воды от вирусного загрязнения, проведенного на модельных водах с исходной концентрацией норовирусов и гепатита А до  $1 \times 10^9$  ТЦД/мл и ротавирусов - до  $1 \times 10^{10}$  ТЦД/мл.
2. В ресурсных испытаниях картриджей АРАГОН-БИО получен 100% вирулицидный эффект в отношении ротавирусов при их концентрации  $1 \times 10^8$  ТЦД/мл на протяжении всего ресурса (50 л, 200 л, 1000 л, 2000 л и 5000 л).
3. Оценка эффективности очистки воды в аварийных ситуациях от бактериального загрязнения, проведенное на водопроводной воде, контаминированной канализационными стоками с исходной концентрацией E.coli  $2,2 \times 10^5$  КОЕ/мл показало, что картриджи АРАГОН-БИО обеспечивают 100% эффективность задержки E.coli и соответствие очищенной воды требованиям, предъявляемым к питьевой воде.
4. Оценка эффективности очистки воды от различных химических загрязнений, в частности, металлов при их начальной концентрации 2ПДК показало, что ионообменные картриджи АРАГОН-БИО обеспечивают эффективную очистку от свинца (75%), алюминия (96%), железа (98%), меди (92%).
5. На основании данных физико-химических и микробиологических исследований фильтры с ионообменными картриджами АРАГОН-БИО рекомендованы для дообеззараживания (E.coli, гепатит А, ротавирусы, норовирусы) и доочистки водопроводной воды от химических загрязнений (свинец, алюминий, железо, медь) и улучшения органолептических показателей. Фильтры с картриджем АРАГОН-БИО могут быть рекомендованы для использования в дошкольных и школьных учреждениях, учреждениях социального профиля, лечебных и других учреждениях.

Зав. лабораторией гигиены питьевого  
водоснабжения и санитарной охраны водоемов,  
д.м.н., профессор



*Р.И. Михайлова*  
Михайлова Р.И.

*“The tested Aragon cartridges have shown 100% water decontamination efficiency from viral pollution The tests were conducted on model with initial concentration of Norovirus and Hepatitis A ( $1 \times 10^9$  TCD/m/ml) and Rotavirus ( $\approx 1 \times 10^{10}$  TCD/m/ml)”.*





Федеральное государственное бюджетное учреждение  
**Научно-исследовательский институт ГРИППА**  
Министерства здравоохранения и социального развития  
Российской Федерации

#### Заключение

**По результатам проведенных исследований по оценке барьерной функции картриджей «АРАГОН-БИО» в отношении ротавирусов и норовирусов при очистке водопроводной воды**

На базе Федерального государственного бюджетного учреждения «Научно-исследовательский институт гриппа» Министерства здравоохранения и социального развития Российской Федерации (ФГБУ «НИИ гриппа» Минздравсоцразвития России) было проведено исследование барьерной функции материала «АРАГОН-БИО» в отношении ротавирусов и норовирусов, являющихся наиболее распространенными возбудителями острых кишечных инфекций, передающихся через воду.

На основании проведенных испытаний были сделаны следующие выводы:

1. Фильтр «Гейзер БИО» с картриджем «АРАГОН-БИО» удаляет из воды 99,99% опасных для человека патогенов - ротавирусов и норовирусов.
2. Максимальная концентрация вирусов в воде, полностью задерживаемая картриджем «АРАГОН-БИО», составила  $1,0 \times 10^8$  частиц/л для ротавирусов и  $0,5 \times 10^7$  частиц/л для норовирусов, что более чем в 1000 раз превышает максимально возможную концентрацию патогенных вирусов в водопроводной воде.

Таким образом, на основании результатов проведенных вирусологических исследований фильтр «Гейзер БИО» для воды с картриджем «АРАГОН-БИО» можно рекомендовать как простое и эффективное средство дообеззараживания водопроводной воды. Фильтры «Гейзер БИО» могут быть рекомендованы для постоянного использования в дошкольных и школьных учреждениях, учреждениях социального профиля, лечебных и других учреждениях.

Директор ФГБУ «НИИ гриппа»  
Минздравсоцразвития России  
Академик РАН

О.И.Кислев

“The ARAGON BIO filter removes 99.9% of human pathogens, i.e. rotaviruses and noroviruses, from water.

The maximum concentration of viruses in water, completely retained by the filter, is amounted to  $1.0 \times 10^8$  U/L for rotaviruses and  $0.5 \times 10^7$  for noroviruses. That is approximately 1000 times higher than maximum possible concentration of pathogenic viruses in the tap water.”



# Opinion of Università di Ferrara, Italy



UNIVERSITÀ DEGLI STUDI DI FERRARA / UNIVERSITY OF FERRARA  
DIPARTIMENTO DI MEDICINA SPERIMENTALE E DIAGNOSTICA - DPT. EXP. & DIAGNOSTIC MEDICINE  
SEZIONE DI MICROBIOLOGIA - SECTION OF MICROBIOLOGIST - Via Luigi Borsari, 46 - 44100 FERRARA - ITALY

## REPORT EFFICACIA VIRUCIDA/ EVALUATION OF VIRUCIDAL ACTIVITY

### CONCLUSIONI / CONCLUSIONS:

Sulla base dei risultati ottenuti, rispettati i criteri di validità del saggio, il filtro "Geysler filter for water treatment" è risultato **VIRUCIDA**, in condizioni di pulito (0,3 gr/l albumina) e in condizioni di sporco (3 gr/l albumina + 3 ml/l di eritrociti), nei confronti di *Polyovirus* tipo 1, ceppo LSc-2ab e di *Herpes simplex virus* Tipo 1, ceppo KOS, dopo il tempo di filtrazione, dimostrando una riduzione della vitalità corrispondente a una riduzione > 99,999 %, secondo quanto previsto dal metodo di prova e dai requisiti della norma UNI EN 14476:2007 – Fase 2 / Stadio 1.

According to EN 14476: 2007 - Phase 2 / Step 1 standard, the product "filtro "GEYSER FILTER FOR WATER TREATMENT" possesses **VIRUCIDAL ACTIVITY**, under clean condition (0,3 gr/l bovine albumin) and dirty condition (3 gr/l bovine albumin+ 3 ml/l erythrocytes), was obtained viral reduction equal at least 99,999%, for referenced strains *Polyovirus* type 1, LSc-2ab and *Herpes simplex virus* type 1, KOS.

Ferrara: 25/01/2012  
Ferrara: January 25<sup>th</sup> 2012



*Pier Giorgio Balboni*

(Firma / Signature Prof. Pier Giorgio Balboni)  
UNIVERSITÀ DI FERRARA  
DIP. TO MEDICINA SPERIMENTALE E DIAGNOSTICA - SEZIONE DI MICROBIOLOGIA  
DPT. EXP. & DIAGNOSTIC MEDICINE - SECTION OF MICROBIOLOGIST  
/ UNIVERSITY OF FERRARA

*“According to the results of laboratory tests due to UNI EN 14476:2007 - phase 2, first step, the filter “Geysler” has antiviral activity and removes herpes virus LSc-2a of the first type and also circulating poliovirus from water. The laboratory tests have proven the reduction of viral load by 99,999%, which is in compliance with the declared standards and the requirements of UNI EN 14476:2007 – phase 2, first step. The filter’s efficiency has been determined as a result of laboratory tests of albumin (0.3 g/l) and also albumin (3 g/l) + erythrocytes (3 ml/l).”*



# Opinion of Università di Ferrara (Italy)



UNIVERSITÀ DEGLI STUDI DI FERRARA / UNIVERSITY OF FERRARA  
DIPARTIMENTO DI MEDICINA SPERIMENTALE E DIAGNOSTICA / DPT. EXP. & DIAGNOSTIC MEDICINE  
SEZIONE DI MICROBIOLOGIA / SECTION OF MICROBIOLOGY - Via LUIGI BORSARI, 46 - 44100 FERRARA - ITALY

## REPORT EFFICACIA VIRUCIDA/ EVALUATION OF VIRUCIDAL ACTIVITY

### CONCLUSIONI / CONCLUSIONS:

Sulla base dei risultati ottenuti, rispettati i criteri di validità del saggio, il filtro "GEYSER FILTER FOR WATER TREATMENT" ha dimostrato l'attività VIRUCIDA NEI CONFRONTI DEI BATTERIOFAGI, dopo il tempo di filtrazione, in presenza di sostanze interferenti dimostrando una riduzione della vitalità corrispondente a una riduzione >99,99 % del batteriofago MS2, secondo quanto previsto dal metodo di prova e dai requisiti della norma UNI EN 13610:2004 – Fase 2 / Stadio 1.

*According to EN 13610: 2004 - Phase 2 / Step 1 standard., the product "GEYSER FILTER FOR WATER TREATMENT" possesses VIRUCIDAL ACTIVITY AGAINST BACTERIOPHAGES, after filtration with interfering substances was obtained viral reduction > 99.99%, for referenced strains Bacteriophage MS2.*

Ferrara: 20/06/2012  
Ferrara: June 20<sup>th</sup> 2012



*Pier Giorgio Balboni*

(Firma / Signature Prof. Pier Giorgio Balboni)  
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DIP. TO MEDICINA SPERIMENTALE E DIAGNOSTICA – SEZIONE DI MICROBIOLOGIA  
DPT. EXP. & DIAGNOSTIC MEDICINE - SECTION OF MICROBIOLOGY  
/ UNIVERSITY OF FERRARA

*“According to the results of laboratory tests, the Geysler filter has antiviral activity and removes bacteriophages from water. The laboratory tests have confirmed the reduction of MS 2 bacteriophage by 99.99%, which is in compliance with the declared standards and the requirements of EN 13610:2004“.*



# Institut Pasteur de Lille (France)

*The institute took its name from the famous French microbiologist Louis Pasteur, the founder and the first director. Louis Pasteur was buried in Notre-Dame de Paris cathedral for his prominent services to France, but later reburied in the territory of the Institute (Lille).*



Important discoveries have been made In Pasteur Institute. That contributed to successful control of such virulent diseases as diphtheria, tetanus, tuberculosis, poliomyelitis, influenza, yellow fever and plague. In 1983 the human immunodeficiency virus was discovered in the institute. Since 1908 ten scientists of the institute have received Noble Prizes for Medical Science and Physiology.



# How the Tests Were Conducted?

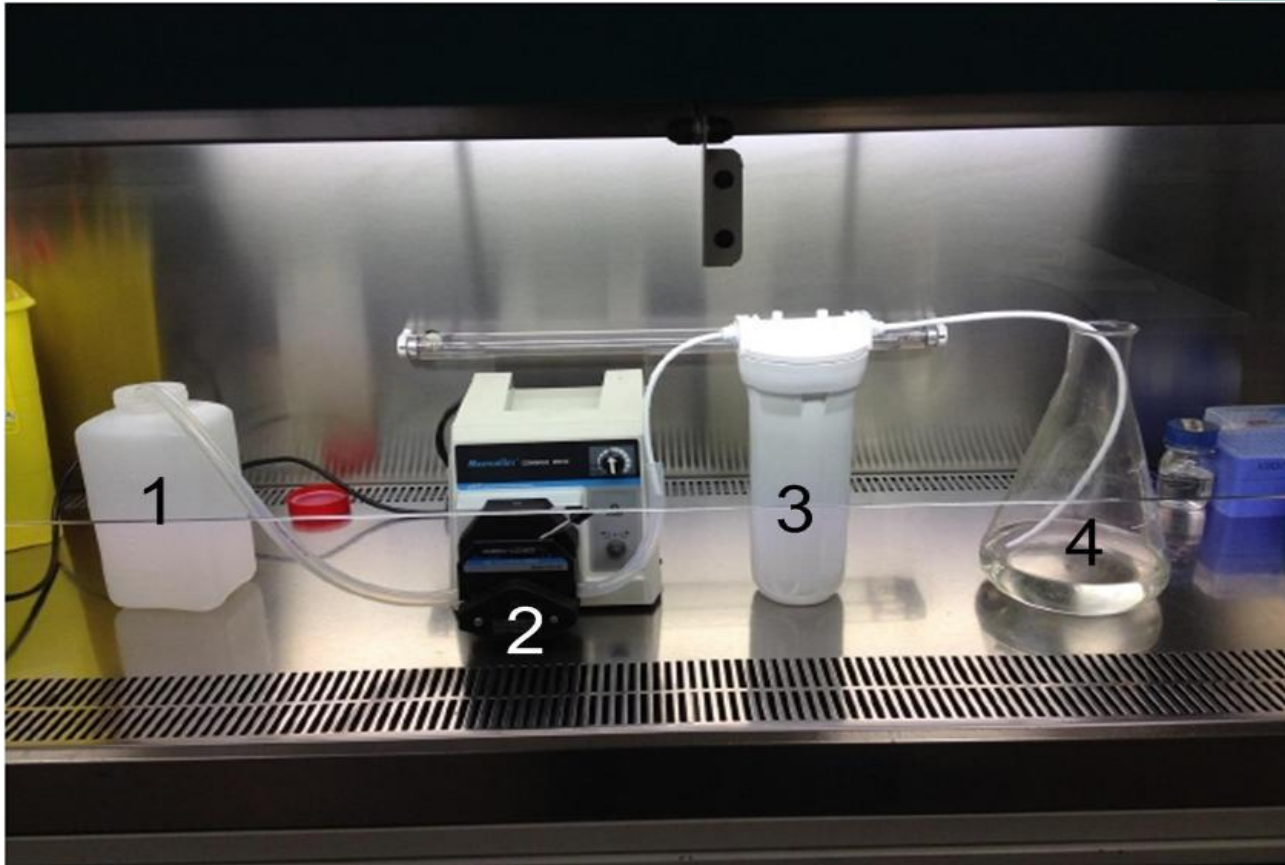


The filtering modules made of ARAGON were taken randomly from the batch. They were placed into a standard series-produced plastic housing. A peristaltic pump was used to circulate water through the modules. Each module was tested once. The tests were conducted with the use of artificially contaminated ultrapure water. Pollution-free water passed through the module prior to the experiment then contaminants were added and the treated water was collected after being filtered.

**Photo:** the modules and the housing presented to the Institut Pasteur de Lille



# Laboratory Setup



- 1 – The capacity with artificially polluted water
- 2 – The peristaltic pump
- 3 – The filter with the module made of Aragon material
- 4 – The capacity with water collected downstream of the filter

# The photo was presented by Institut Pasteur de Lille

# Removal of Bacteria and Viruses



Test strains of bacteria and viruses typical for water supply networks have been selected for the testing.

## Strains and Media. Bacteria.

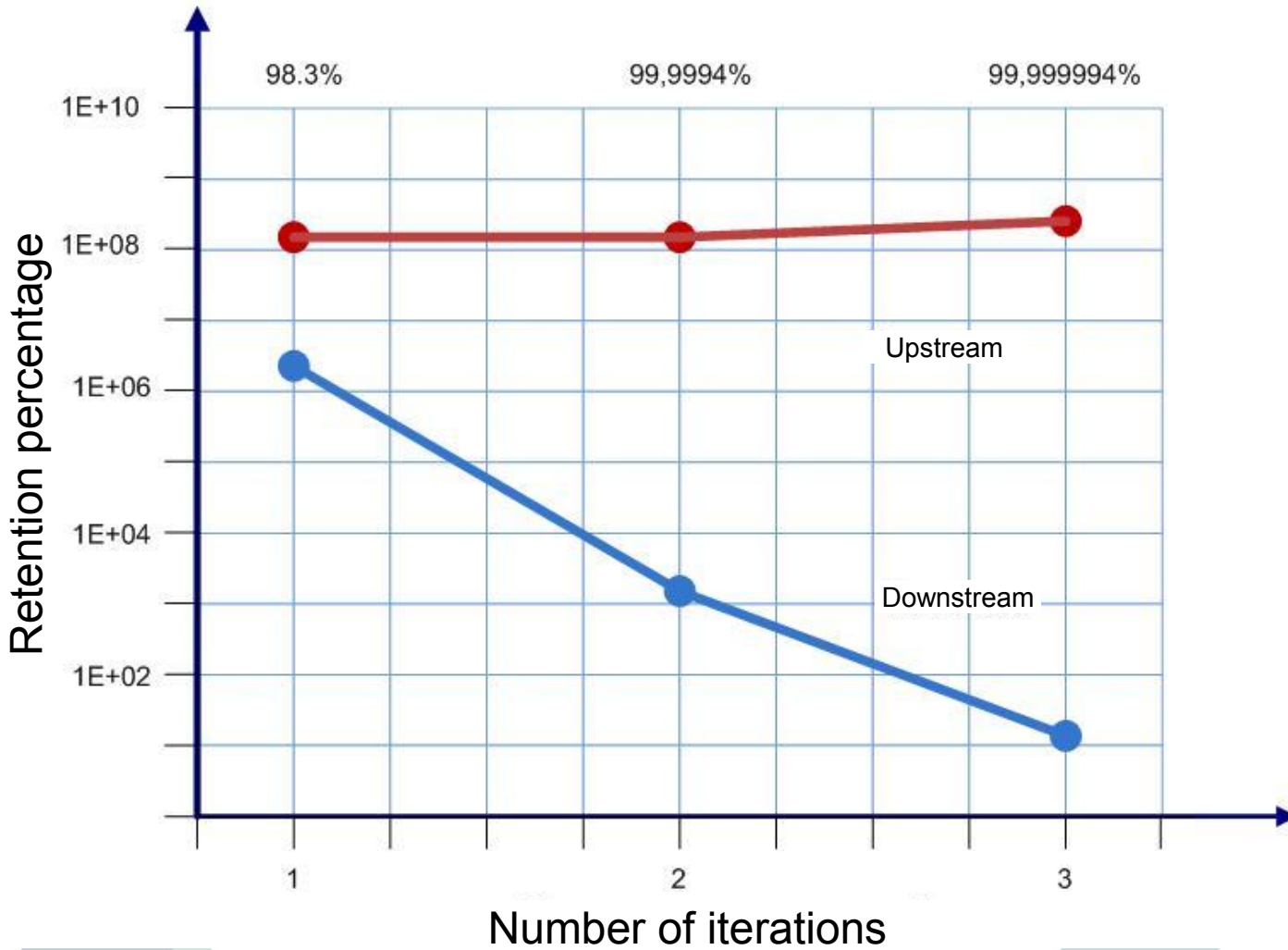


**Salmonella** is a mouse typhus agent. Nonspore-forming rod-shaped bacteria. Length: 1-7  $\mu\text{m}$ ; width: around 0.3-0.7  $\mu\text{m}$ . The salmonellas are gram-negative mobile facultative-anaerobic bacilli.

Growth and counting medium: Trypticase soy agar.

# Removal of Salmonella

Content in the sample





# Strains and Media. Bacteria.



## Legionella pneumophila

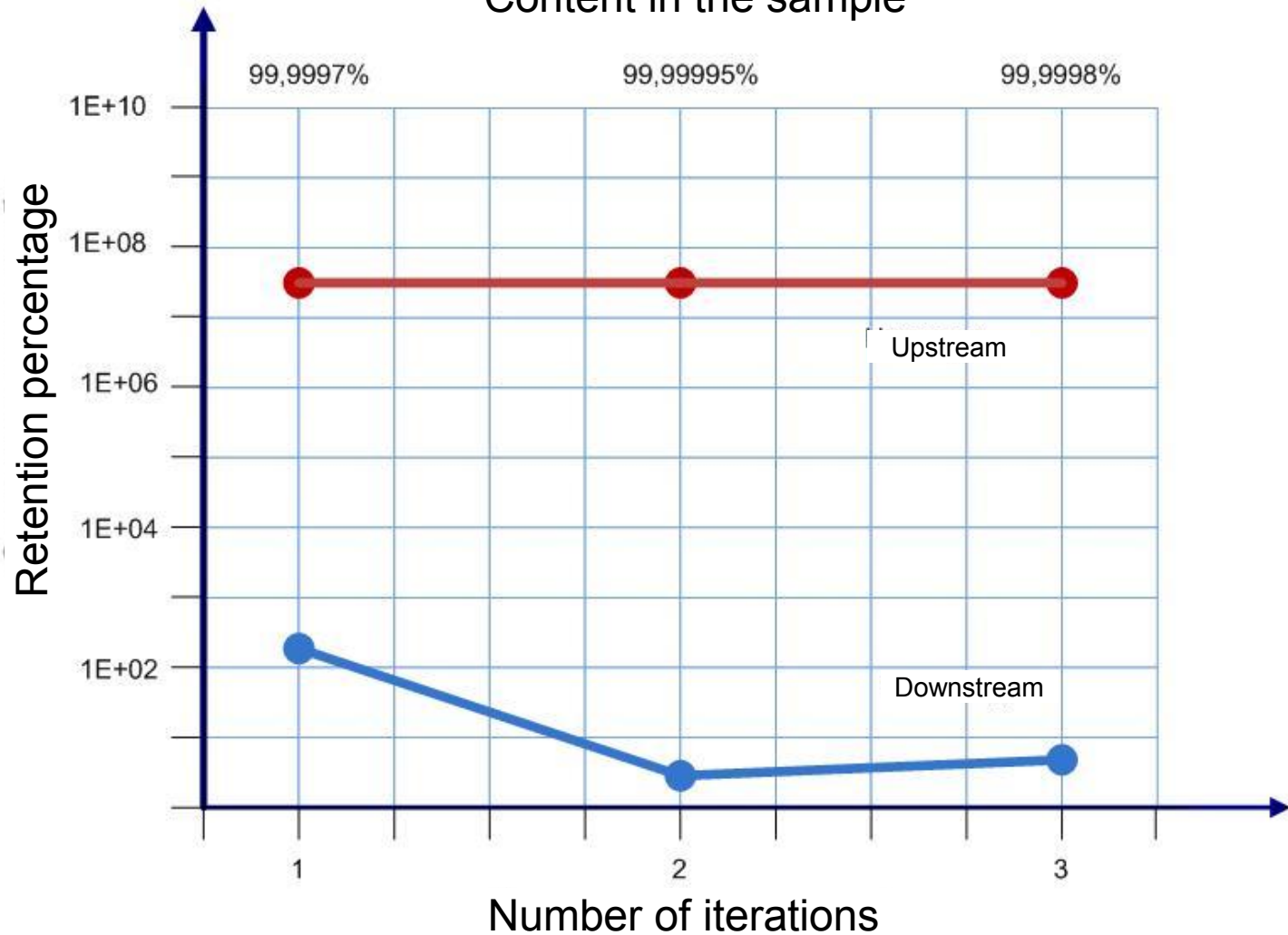
are pathogenic gram-negative bacteria.  
Diameter: 0.2 to 0.7  $\mu\text{m}$ ,  
length: 2 to 20  $\mu\text{m}$ .

**Legionella pneumonia** (legionaries' disease). The disease has been known since 1976 when it appeared as ARVI outbreak. This outbreak was characterized by severe pneumonia and high lethality among the participants of “American Legion”, veterans organization’s congress in Philadelphia. 182 of 4400 persons taking part in the congress fell ill, 29 of them died. Meanwhile the term “legionaries’ disease” first appeared. The most common agent is Legionella pneumophilla. The inhabitation places of legionella are fresh water bodies and soil and also water supply and air conditioning systems in buildings, heating water converter plants and shower facilities, fountains, etc.

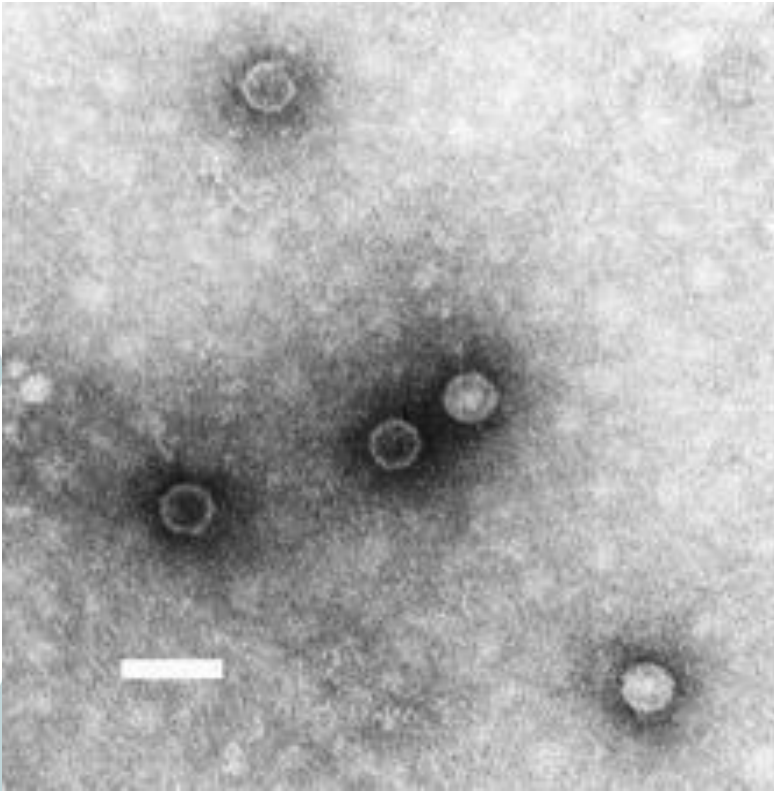


# Removal of Legionella

Content in the sample



# Strains and Media. Viruses.



## Poliovirus

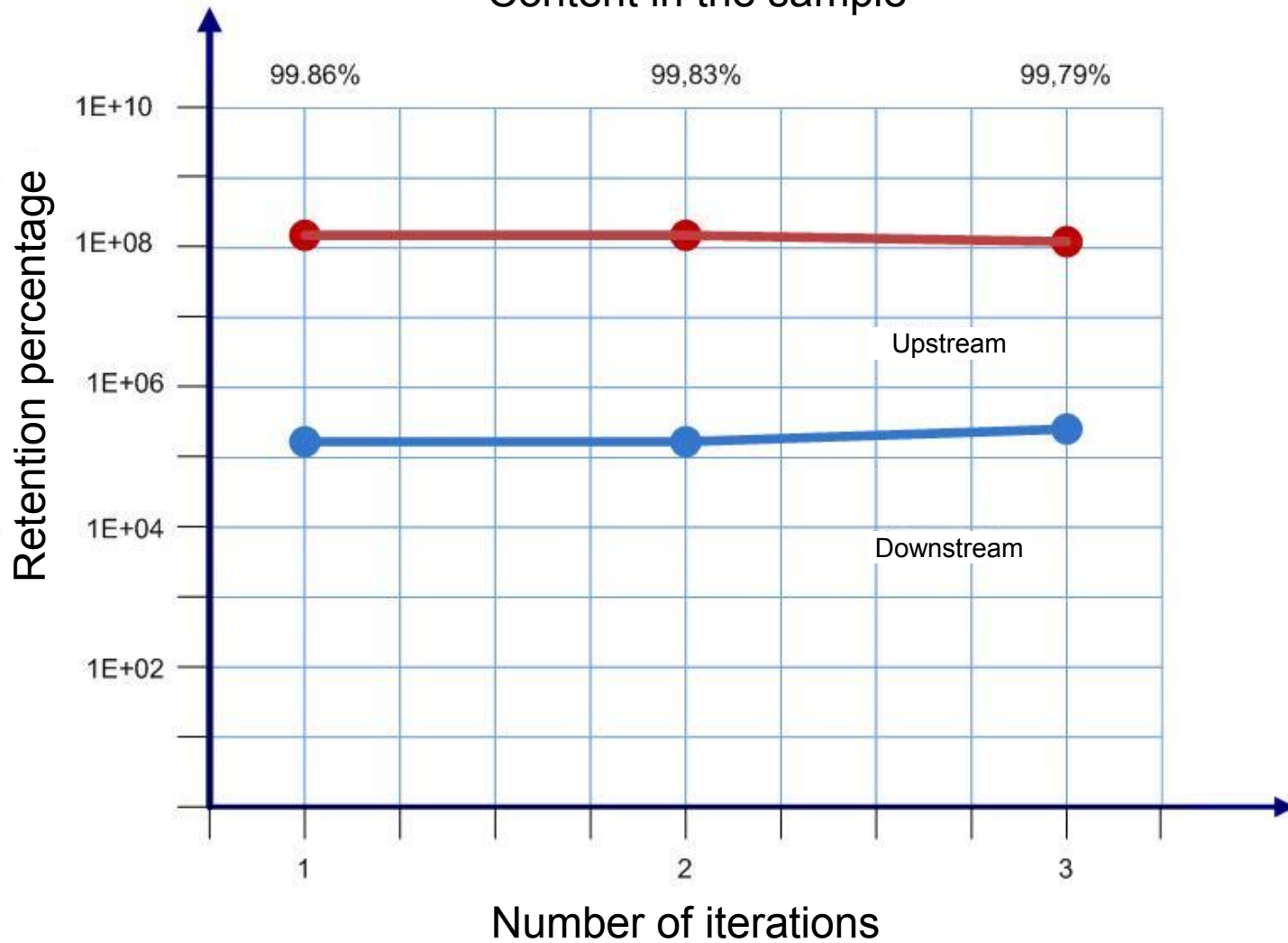
**(Poliovirus strain Sabin type I)** belongs to the family Picornaviridae, enterovirus (enteric virus) group.

Virus size: 27-30  $\mu\text{m}$ .

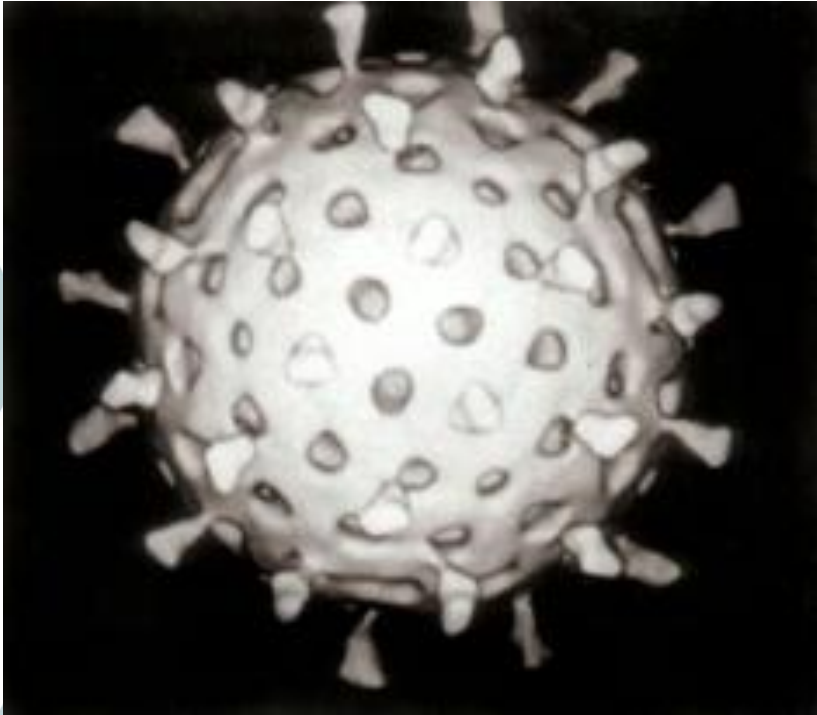
Production and titration were on the BGMK cells  
(African green monkey's kidney).

# Removal of Poliovirus

Content in the sample



## Strains and Media. Viruses.



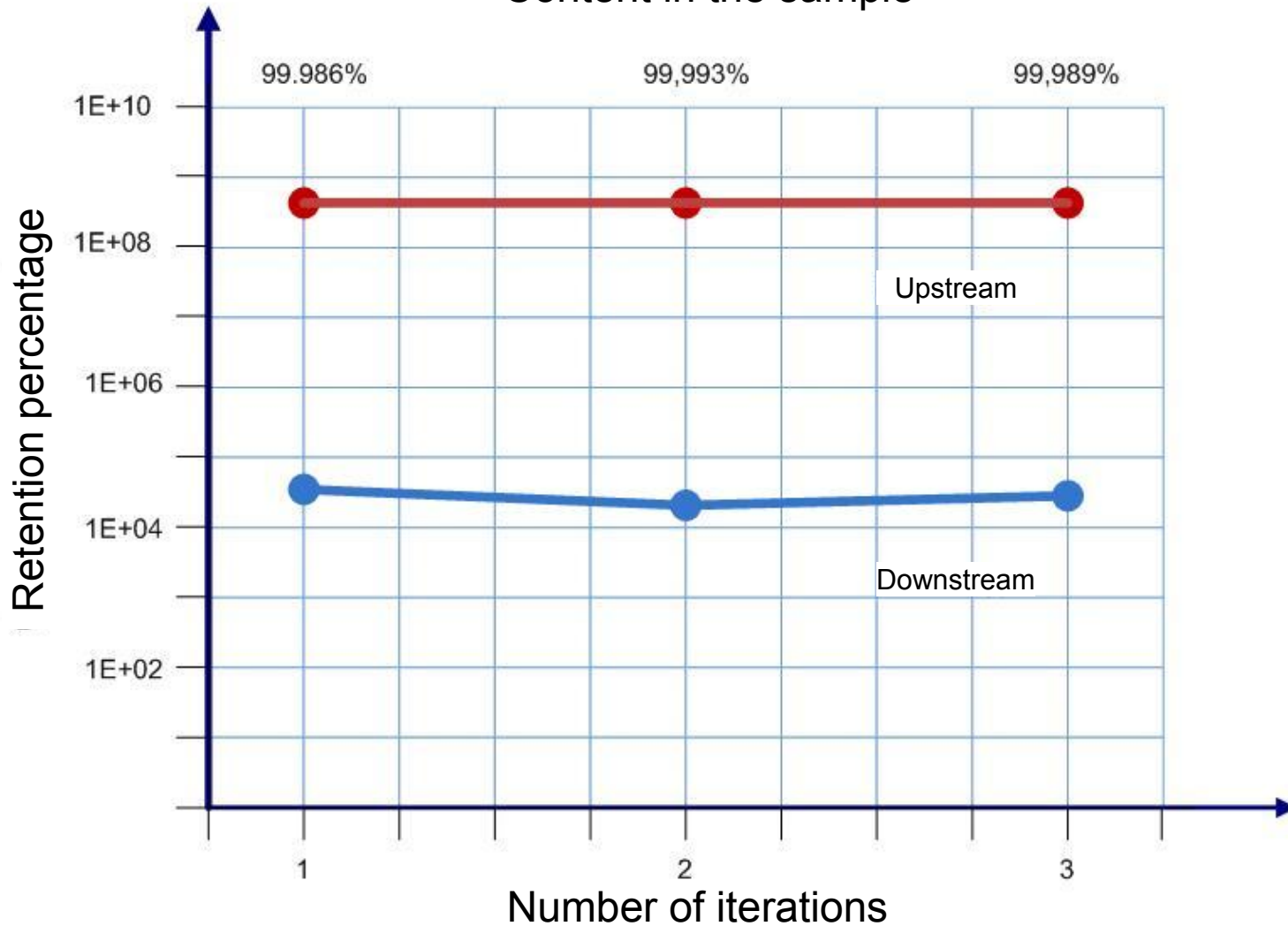
**Rotavirus** is an enveloped virus with two-strand fragmented RNA belonging to the family Reoviridae, rotavirus infection agent.

Virus size: 76.5  $\mu\text{m}$  in diameter.

Production and titration were on the primates MA104 cells.

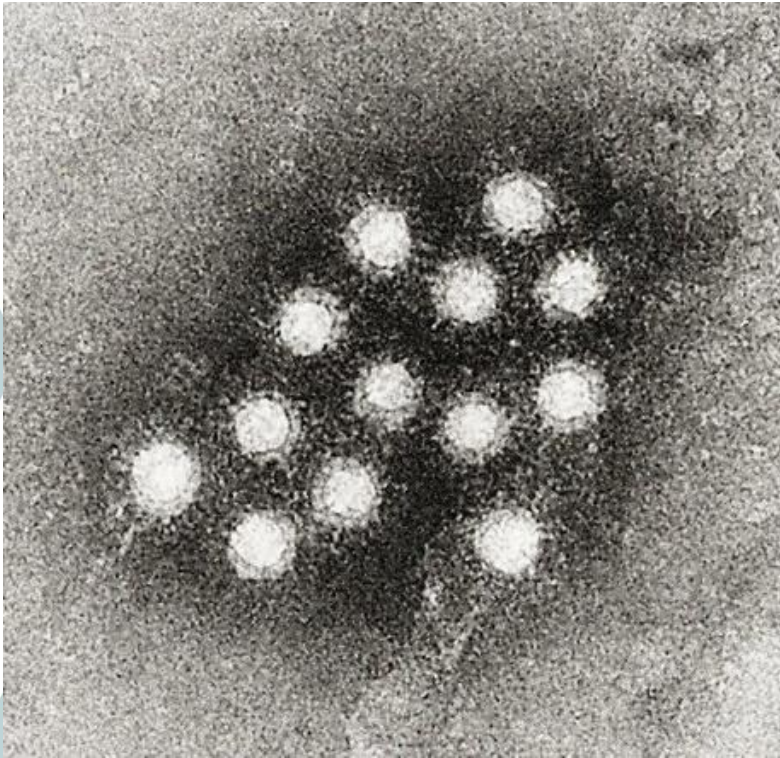
# Removal of Rotavirus

Content in the sample





## Strains and Media. Viruses.

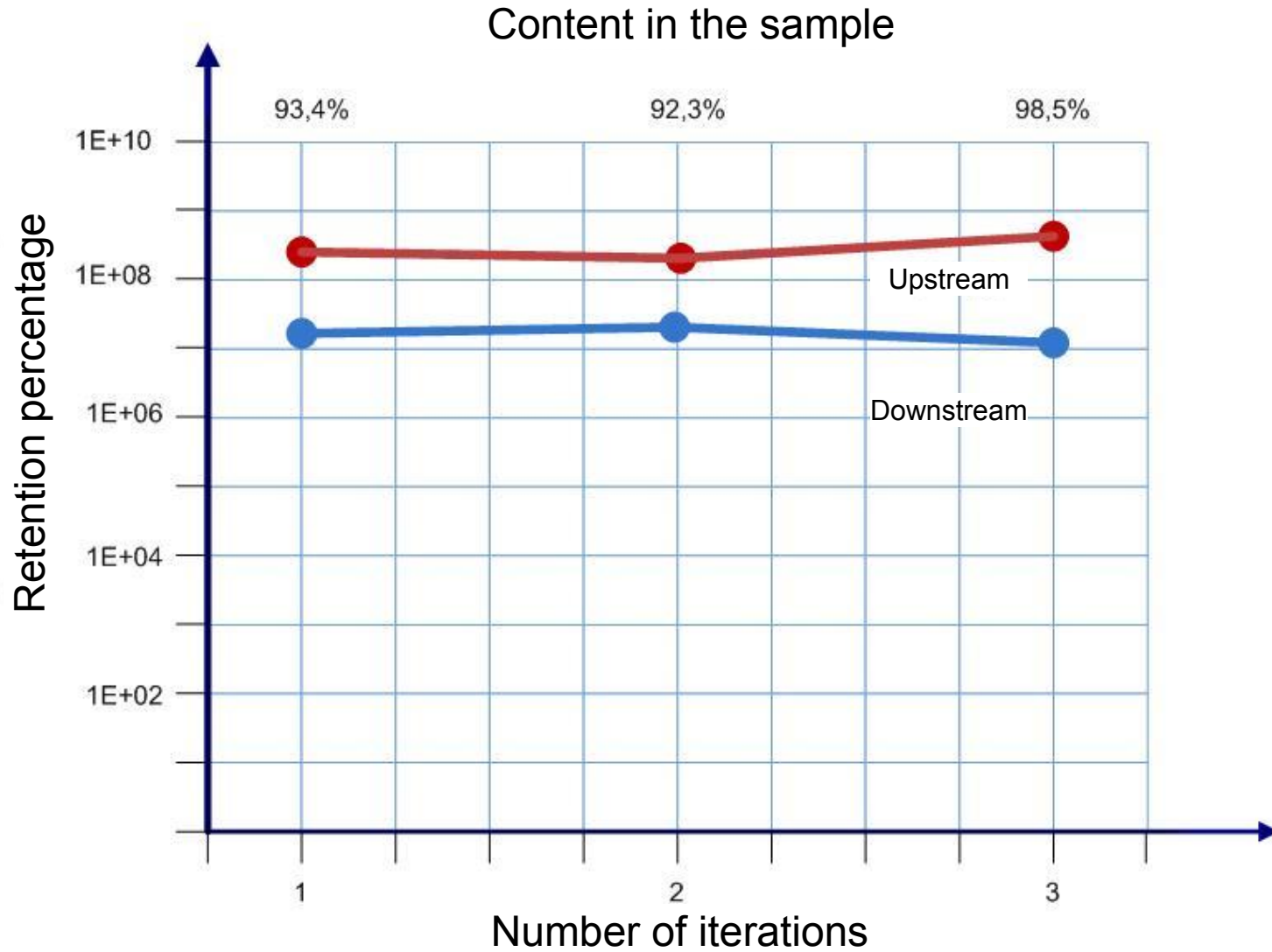


Hepatitis A (formerly known as infectious hepatitis) belongs to Picornaviridae family of viruses. It has no envelope and contains (+) single-stranded RNA packaged into protein capsid.

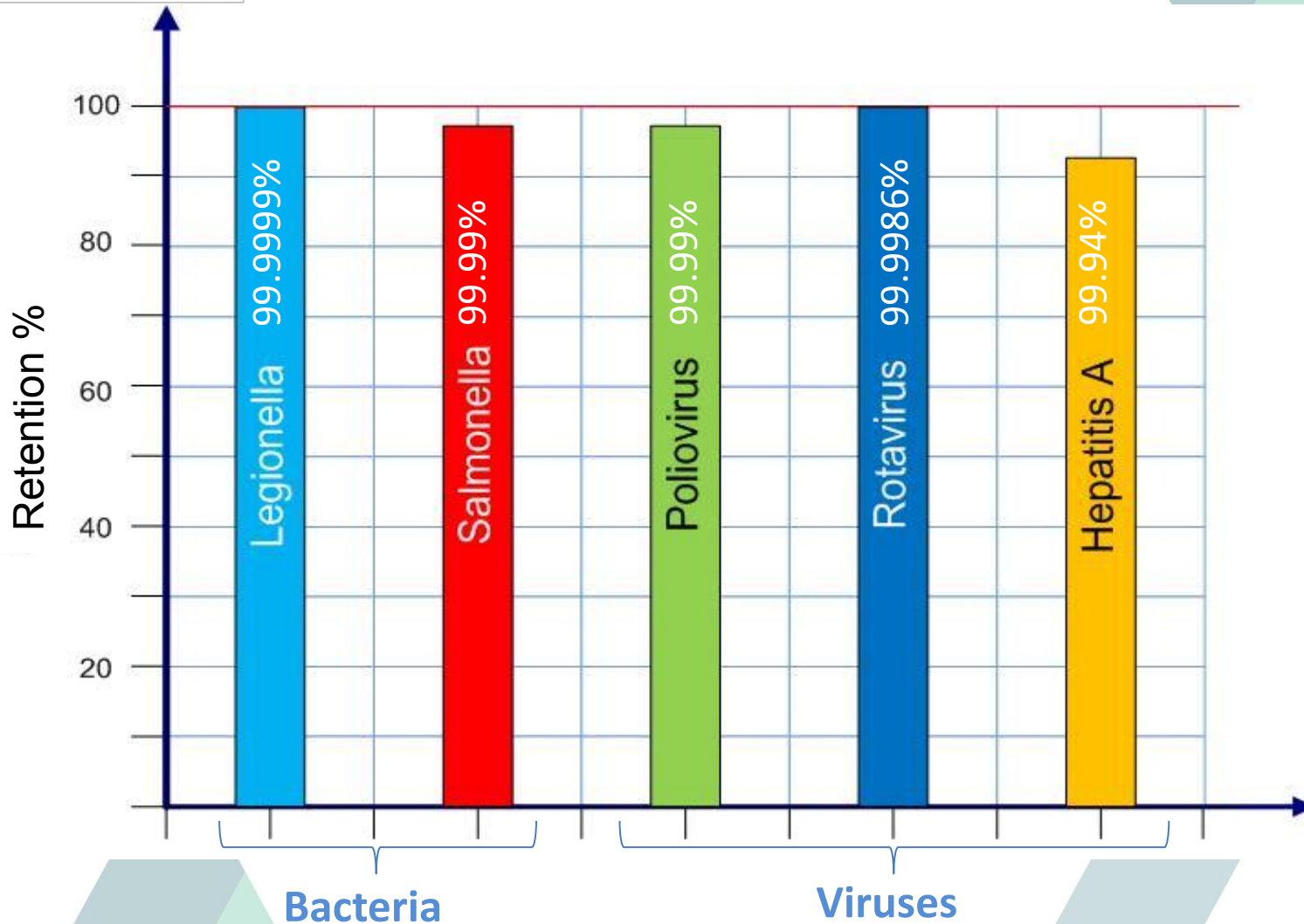
Size: 27  $\mu\text{m}$  in diameter.

Production and titration were on the primates FRhK4 cells.

# Removal of Hepatitis A



# Efficiency of Viruses and Bacteria Removal



# The Institut Pasteur de Lille (France) Conclusion



Institut Pasteur de Lille  
Unité de Sécurité Microbiologique – Microbiological Safety Unit  
1 rue du Professeur Calmette – BP 245 – 59019 Lille Cedex – France

## REMOVAL OF MICROORGANISMS FROM WATER BY GEYSER FILTERS

According to a test protocol based on filtration of artificially contaminated ultrapure water, GEYSER filters ARAGON BIO were able to remove bacterial and viral contamination with the following values (obtained in separate experiments):

- *Legionella pneumophila* serogroup 1 (CIP 103854), mean removal 99.99987% (5.9 log)
- *Salmonella* Typhimurium (ATCC 14028), mean removal 99.998% (4.8 log)
- Poliovirus strain Sabin type 1, mean removal 99.84% (2.8 log)
- Rotavirus strain simiens SA114F1, mean removal 99.99% (4.0 log)
- Hepatitis A virus strain HM175/18f (ATCC VR-1402), mean removal 96% (1.4 log)

Lille, September 3<sup>rd</sup>, 2014



Dr. Michèle Vialette  
Head of the Microbiological Safety Unit  
Institut Pasteur de Lille

*The Geysler filters were able to remove the tested bacteria from water, with log reductions ranging from 5.3 to 7.3. Removal efficiency was lower concerning the viruses with mean log reductions of 2.8 (poliovirus), 4.0 (rotavirus) and 1.4 (hepatitis A).*



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## Summary

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Saint Petersburg, 2014



# The Market Opportunities of ARAGON

- **Domestic use**

- Potable water filtration both at home and outdoors
- Water supply of houses
- Water purification in emergency zones, including areas under the radioactive pollution conditions
- Water treatment in mainlines

- **Commercial use**

- Treatment and purification systems for discharges
- Hot water supply (boilers)
- Pre-filtration in the membrane filtering systems
- Pre-filters for mainlines

# Conclusion

**Aragon BIO** represents the most up-to-date technology for water treatment and viruses, bacteria and cists removal. That makes it possible to get completely safe and health-promoting water without boiling.

**Aragon BIO** can be used as well as the main element in water treatment and decontamination systems and as one of the pre-treatment stages, e.g. as a part of the membranes protection against bio contamination.

**Aragon BIO** is comparable to polymeric UF/MF membranes (that are for domestic use) in efficiency. But it has greater productivity and significantly lower pressure drop.

**Aragon BIO** provides higher efficiency of filtration and kinetic absorption as compared to standard nonwoven fabrics including granular activated carbon.

**Aragon BIO** is absolutely environmentally-friendly. It can be used for potable water treatment and decontamination according to GOST R 51871-02, 51232-98.

# THANK YOU FOR YOUR ATTENTION!

Geyser Company

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