



**TNS ADDITIVES WITH ANTIVIRAL  
AND ANTIBACTERIAL ACTIVITY**

Dear colleague, you have probably been following the evolution of products and technological advances in the battle against invisible enemies, such as virus and bacteria, which are now, more than ever, present in our daily lives.

TNS is committed to act decisively in the fight against these microorganisms, by launching innovative products, such as additives with antiviral and antimicrobial activity.

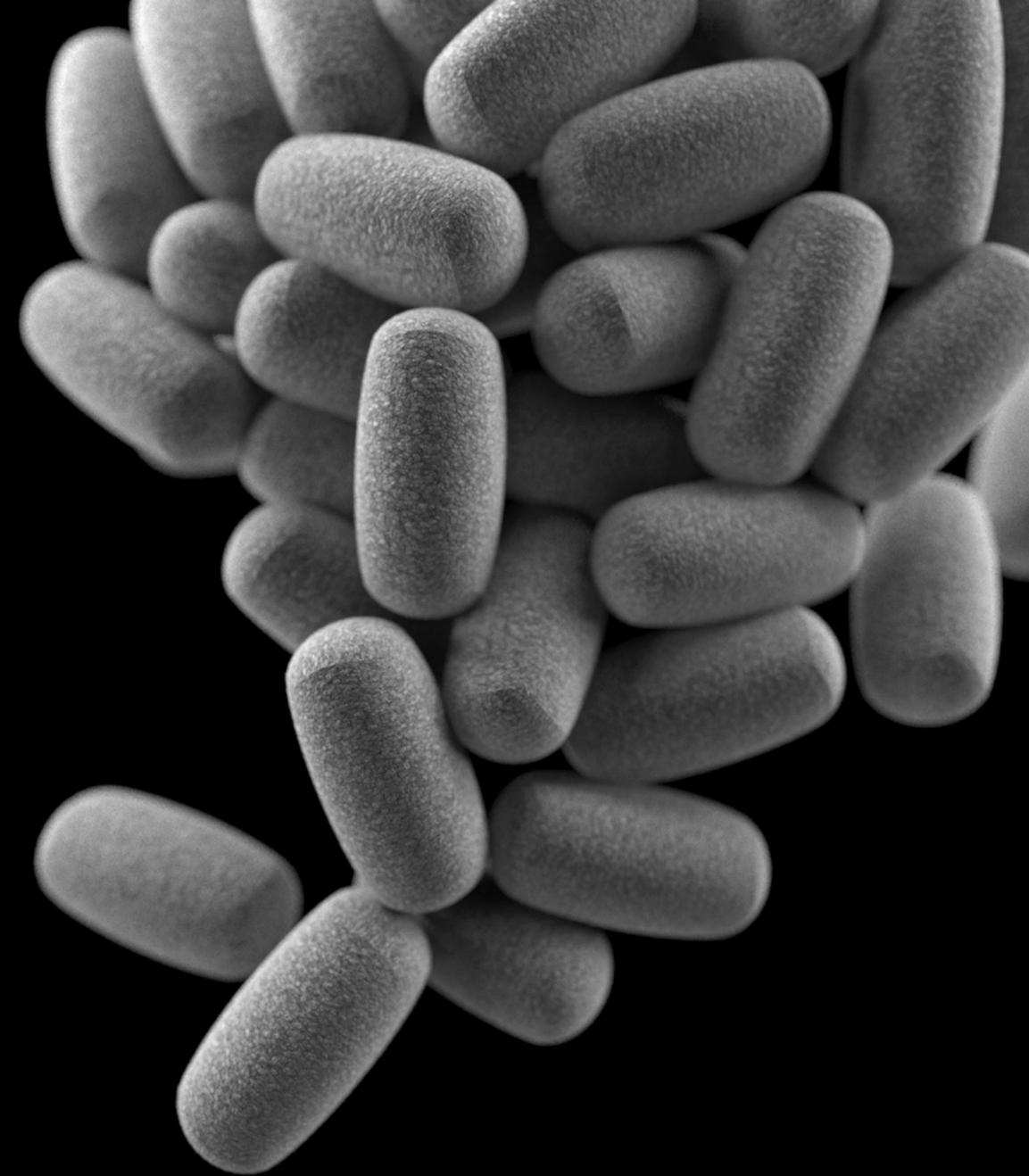
It is important to be aware of the basic recommendations, regulations and guidelines that apply to these products.

Therefore, we would like to share this material with you, as a way of supporting the technical and sales departments of your company. Enjoy the read!



**We have developed this material in order to assist you, by answering possible questions you may have regarding this new technology when creating your promotional material.**

**One of our recommendations is not to link the product to the virus, but to its antiviral activity.**



# HISTORY OF ANTIMICROBIALS

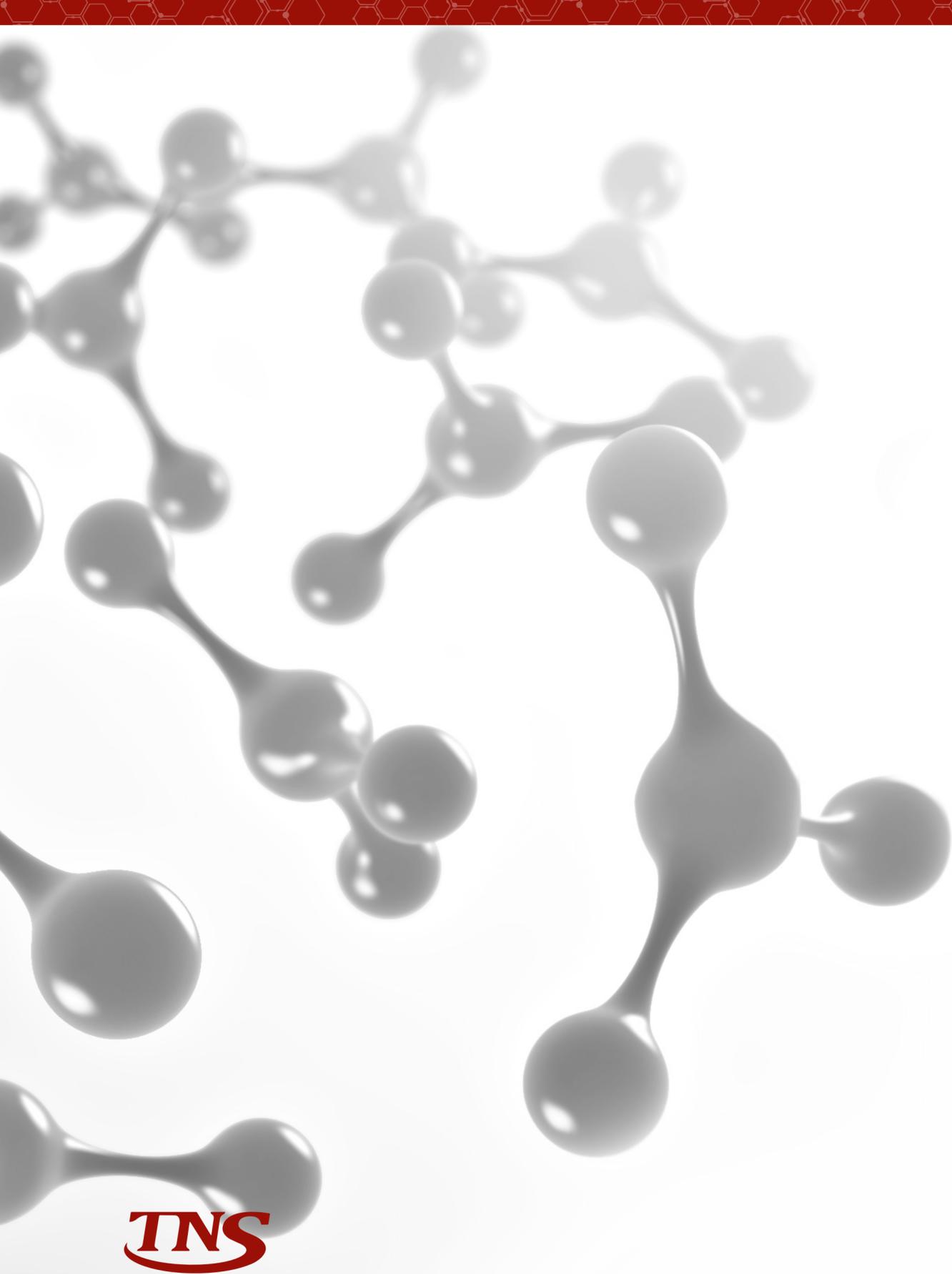
The use of silver as an antimicrobial agent dates back to a remote time and has had wide applicability throughout its history, either as salts, solutions, or particles.

The use of antimicrobials in the form of nanoparticles has now been better understood, tested, and disseminated and has even shown to be more effective than aqueous colloidal silver solutions. Due to the possibility of incorporating **nano silver** into different matrices (bandages, masks, plastic, coatings for surgical instruments, foams), its use has shown to be a logical alternative in the reduction and prevention of **bacterial contamination**, which may lead to general infection in hospital settings.





**Silver-based antimicrobials are an extensive field of study and the source of numerous growth opportunities for this industry. With new innovative products being launched into the market, there are more and options for the control and mitigation of microorganisms, including superbugs and other pathogens. In addition to the nano silver technology, TNS's product portfolio includes other nitrogen and oxide compounds of different kinds.**



Silver ions form the basis of TNS technology, which promotes the **antiviral and antibacterial effect**.

Our technology has been developed to **inhibit the growth and persistence of bacteria and virus** on different materials.

The activity of silver ions, when applied according to the recommendations, was confirmed by the **AATCC 100\*** and **JIS L 1902** (antibacterial activity) and the **ISO 18184\*\*** and **ISO 21702\*\*\*** test methods (antiviral activity).

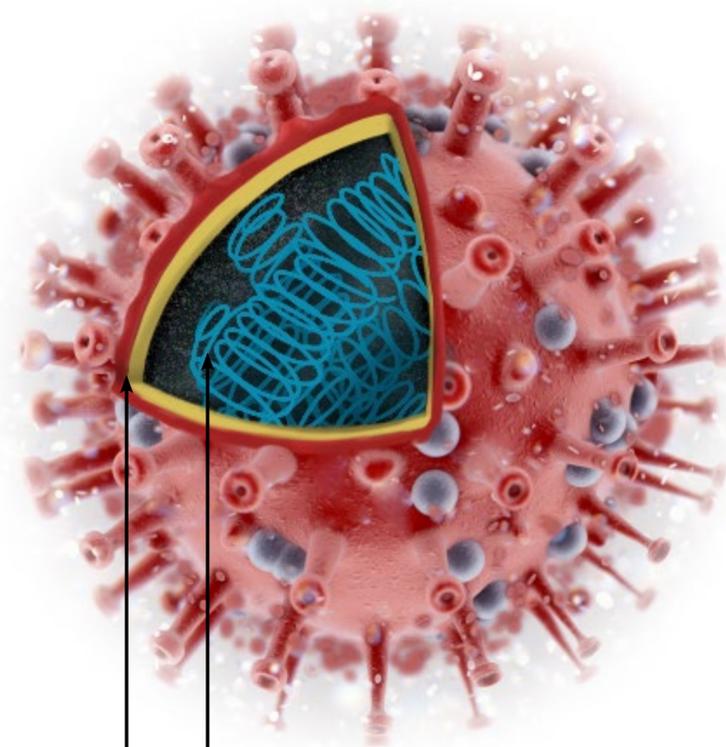
(\*) Tests conducted with *staphylococcus aureus* (Quality assurance test method).

(\*\*) Tests conducted with human adenovirus type 2 (respiratory, non-enveloped) and Sars-Cov-2 (enveloped).

(\*\*\*) Tests conducted with human adenovirus type 2 (respiratory, non-enveloped) and human herpes type 1 (enveloped).

# THE ANTIVIRAL IN ACTION

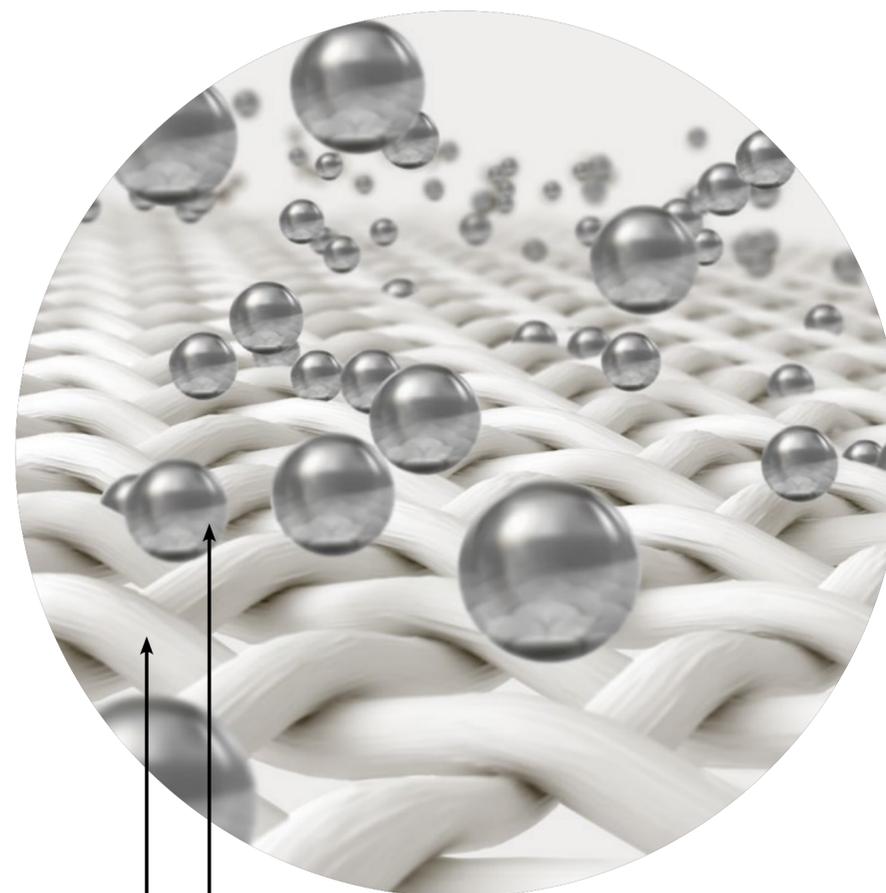
Virus



RNA

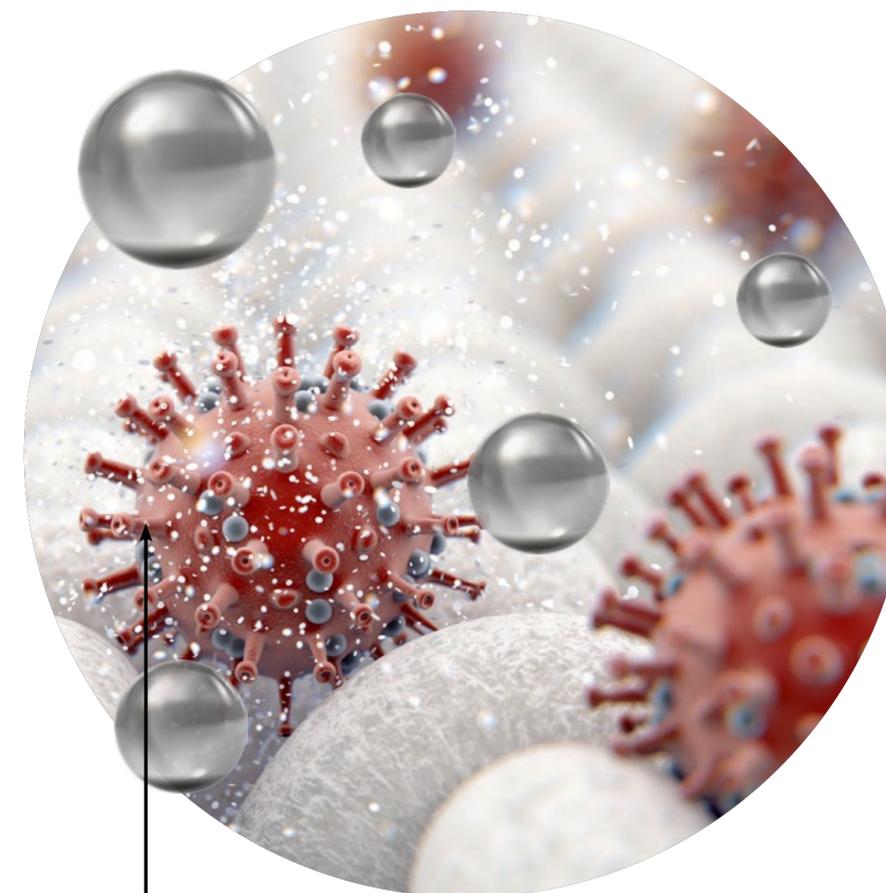
Lipid bilayer

Textile protection with **TNS**



Breaks open the lipid bilayer of the virus  
Inhibits replication of viral DNA/RNA;

Activity of **TNS** additives



Inhibits binding and fusion of the virus in cells



Referências:

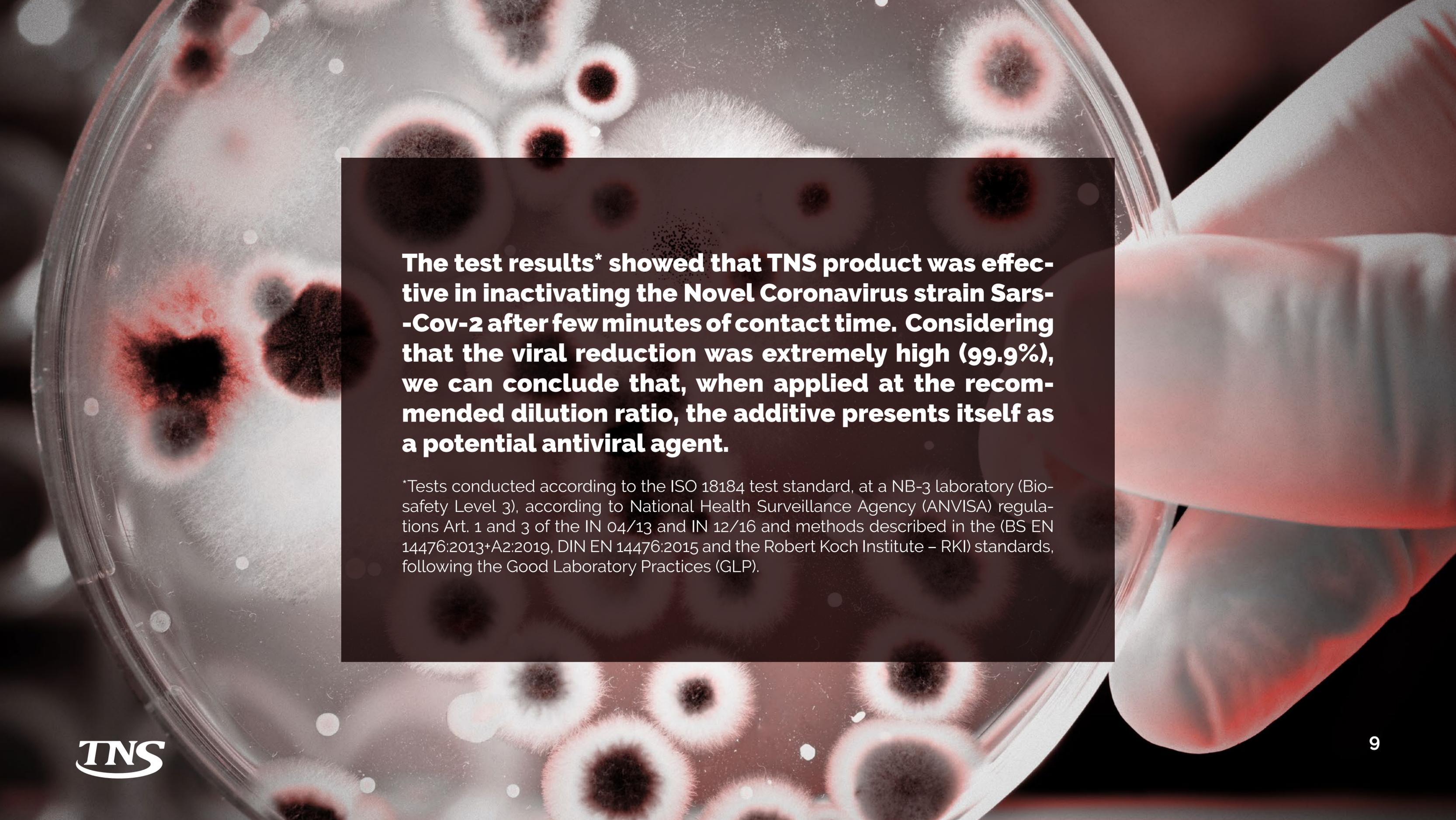
[Breaks open the lipid bilayer of the virus](#)  
[Inhibits binding and fusion of the virus in cells](#)  
[Inhibits replication of viral DNA/RNA](#)

# ENHANCED PROTECTION FOR TREATED ARTICLES

- Silver ions, in liquid or granulated form, have proven to be effective against enveloped and non-enveloped viruses, with no toxicity for **A549 cell lines (ATCC® CCL-185™)** or **Vero cells (ATCC® CCL-81)**;
- Silver ions have proven to be effective against enveloped and non-enveloped viruses in tests with facial masks, textiles, and other applications, significantly reducing the infectivity of virus and bacteria on the treated product;
- Ideal for protective products made of fabric, nonwoven fabric, and foam, such as face masks or nonwoven material for general applications;

- Can be applied to different types of fibers and polymer matrices.

**Contact TNS** for detailed information on treated articles and application recommendations prior to applying and selling the products.

A close-up photograph of a petri dish containing a bacterial culture. The agar surface is covered with numerous colonies of varying sizes, each exhibiting a characteristic dark center surrounded by a lighter, often reddish or pinkish, outer ring. The colonies are densely packed in some areas and more sparse in others. The lighting is dramatic, highlighting the textures of the agar and the individual colonies.

**The test results\* showed that TNS product was effective in inactivating the Novel Coronavirus strain Sars-Cov-2 after few minutes of contact time. Considering that the viral reduction was extremely high (99.9%), we can conclude that, when applied at the recommended dilution ratio, the additive presents itself as a potential antiviral agent.**

\*Tests conducted according to the ISO 18184 test standard, at a NB-3 laboratory (Biosafety Level 3), according to National Health Surveillance Agency (ANVISA) regulations Art. 1 and 3 of the IN 04/13 and IN 12/16 and methods described in the (BS EN 14476:2013+A2:2019, DIN EN 14476:2015 and the Robert Koch Institute – RKI) standards, following the Good Laboratory Practices (GLP).

# PROVEN EFFICACY ON TEXTILES

Têxteis tratados com o aditivo 			
Amostra	Agente	redução Log	redução %
PROTEC-20 Liquid additive (25 g/L)	Adenovirus <sup>a</sup>	3	99.9
	HSV <sup>a</sup>	7	99.99999
PROTEC-20 Liquid additive (20 g/L)	Coronavirus Sars-Cov-2	4	99.99
PROTEC-20 Liquid additive (20 g/L)	Coronavírus MHV-3	3	99.9
Polyester or cotton treated with TNS liquid additive	Adenovirus <sup>a</sup>	2	99
	HSV <sup>a</sup>	2	99

Log reduction,  
1 log corresponds to 90%,  
2 log = 99%,  
3 log = 99.9%,  
4 log = 99.99  
and 7 log = 99.99999%

(a) Tests conducted according to ISO 18184 adapted for virus models, namely, Herpes Simplex Virus type 1 (HSV) and Human Adenovirus type 2 (Adenovirus).



## THE TECHNOLOGY BEHIND SILVER IONS

The silver-based technology attracts the virus with opposite load, making it bind to sulfur groups present on the surface of viral glycoproteins, preventing the virus from binding to the host cell and **blocking its replication**.

Our technology also includes a stabilizing agent that interacts with these viral glycoproteins, favoring the **antiviral and antimicrobial** activities of silver.

Due to its unique optical, physical, chemical, and biological properties, silver has been used in a wide range of applications in various industries, including textiles.

### **Examples of application:**

Protective fabrics, such as masks, air filters, gowns, curtains. For all kinds of natural and synthetic fibers.

# PROVEN EFFICACY IN POLYMERS

Polymers treated with  additive			
Liquid TNS additive applied to synthetic fibers	Agent	Log reduction	% reduction
	Adenovirus <sup>a</sup>	3	99.9
	HSV <sup>a</sup>	3	99.9
Polymer with TNS additive incorporated via masterbatch	Agent	Log reduction	% reduction
	Adenovirus <sup>a</sup>	1	90
	HSV <sup>a</sup>	2	99

(a) Tests conducted according to ISO 18184 and ISO 21702 adapted for virus models, namely, Herpes Simplex Virus type 1 (HSV) and Human Adenovirus type 2 (Adenovirus).

# TEST METHODS

**TNS recommends that antimicrobial tests are carried out according to AATCC 100 (American Association of Textile Chemists and Colorists) and JIS L 1902, and that antiviral efficacy tests follow ISO 18184 (Textiles: Determination of antiviral activity of textile products) and ISO 21702 (Measurement of antiviral activity on plastics and other non-porous surfaces) test methods. Learn more about how our technology can contribute to the success of your industry. [Contact us!](#)**



## WHAT YOU NEED TO KNOW ABOUT SILVER IONS

- **Non-cytotoxic** product, different from most competing technologies;
- Formulation based on the concept of **green chemistry**, with organic and natural stabilizer of Brazilian origin;
- Technology validated by different international standards: **ISO 18 184, ISO 21702, AATCC 100, JIS L 1902 and ASTM E2149**;
- TNS has been in the market for more than 10 years, and was elected by **#Open100Startups**, the **#1** startup in the materials sector.

# FREQUENTLY ASKED QUESTIONS

## **1 – To what type of matrices can the product be applied?**

TNS additives are available in water-based, alcohol-based and masterbatch forms. They can be applied to polymers, such as nonwoven polyester and plastic, as well as to natural fibers, such as cotton. They can also be incorporated into liquid products, such as liquid resins and paint. Do you want to learn more? [Contact our team of experts.](#)

## **2 – How are the antibacterial and antiviral activities of a product quantified?**

TNS recommends that antibacterial tests on textiles be performed according to the AATCC 100 (American Association of Textile Chemists and Colorists), and JIS L 1902 (Determination of antibacterial activity and efficacy of textile products) test methods. For plastics, JIS Z 2801 and ASTM E2149.

As for antiviral efficacy tests, we recommend following ISO 18184 (Textiles: Determination of antiviral activity of textile products) and ISO 21702 (Measurement of antiviral activity on plastics and other non-porous surfaces) test methods.

## **3 – What does log reduction mean?**

In microbiology, we use the term log to express the reduction in the cell culture population in CFU/mL (colony-forming unit) from the original concentration. Log reductions indicate how effective products are at reducing the concentration of microorganisms (viruses, fungi, or bacteria).

So, log reductions are defined as:

1 log = 90% reduction in/inactivation of the activity of viruses, bacteria, or fungi

2 log = 99%,

3 log = 99.9%,

4 log = 99.99%,

5 log = 99.999%

# FREQUENTLY ASKED QUESTIONS

## 4 – How do TNS additives act against the virus?

The exact mechanism of action of these nanoparticles is still poorly understood. However, we know from scientific literature that the active ingredient of silver ions act in the disruption of the lipid bilayer of the virus, reducing the infection capability of the viral DNA/RNA, when exposed to the environment.

Silver ions may also act by inhibiting the virus from binding to host cells. Thus, by blocking the cell entry process, they prevent the virus from releasing its genetic material (DNA or RNA) into the cells, reducing its capacity to infect them. Also, functionalized AgNps have the ability to mimic heparan sulfates, the primary cellular receptor of the Herpes Simplex Virus (HSV), for example. Therefore, TNS additives then compete for virus binding.

## 5 – Are TNS additives effective against coronavirus?

Yes. Their antiviral activity has been confirmed for the enveloped viruses Herpes Simplex Virus Type 1, Coronavirus Strain 3 (MHV-3) and Influenza Virus subtype H1N1. They are also effective against Human Adenovirus type 2 (respiratory, non-enveloped).

## 6 – Are they effective against SARS-Cov-2?

Yes. As previously shown, the Protec-20 additive, in adequate concentration, eliminates 99.99% of the Sars-Cov-2 virus from fabric, according to the ISO 18184 standard (Textiles: Determination of antiviral activity of textile products). However, our suggestion is not to link the product to the virus, but rather to the virucidal action, thus showing its spectrum of action once it manages to inactivate viruses of both classes: enveloped and non-enveloped.

## 7 – Why is it called “novel” coronavirus or SARS-CoV-2?

Because it is the second known coronavirus that affects humans. However, the genetic material of the novel virus is 80% identical to that of SARS (Severe Acute Respiratory Syndrome). The novel coronavirus had to undergo mutations in order to infect humans, as this family of viruses usually circulates only among animals. Research has shown that both SARS and the novel coronavirus infect host cells through ACE2 receptors, present in human lungs, which explains the main symptoms experienced by patients, such as cough, difficulty breathing and pneumonia.

# FREQUENTLY ASKED QUESTIONS

## **8 – What is the difference between TNS's silver-based technology and other antimicrobials?**

TNS additives are antibacterial and antiviral, mono-components that can be used in a wide range of applications in various industries. These are emulsions containing silver nanoparticles, stabilized with organic molecules, which guarantee a safe, efficient, and low concentration application.

## **9 – Can it be harmful to the human body?**

Silver does not occur naturally in animals and human beings but it is present in the air, water, soil, and food. The World Health Organization (WHO) has established a threshold limit value for lifetime intake of about 10 g of silver. The Environmental Protection Agency (EPA) classified silver as a Group D carcinogen - one that is not classifiable as carcinogen in humans - and established a daily intake limit of 0.005 mg/kg.

According to a study, "Ionic silver is unique in comparison with other antibiotics in that it has no toxicity and carcinogenic activity. Silver ion is a disinfectant for non-spore-forming bacteria, such as *Salmonella* spp., *Staphylococcus* and *Escherichia coli*, at concentrations about 1,000 times lower than the levels at which it is toxic to mammalian life. This extreme mammalian-to-bacterial toxicity differential is the definition of an oligodynamic material."

## **10 – How are TNS products applied?**

The application does not require the use of auxiliary products, they can be incorporated even during conventional processing steps. Some of the processes that have been used in the incorporation of silver nanoparticle products in the industry include: padding and exhaustion of synthetic and natural fibers; direct incorporation into the thread (polymerization or extrusion); pelletizing compound and resins; during the manufacturing of plastic, coatings and paints.

**We hope this was helpful.**

**If you still have questions, we will be happy to help you.**

**Contact us!**



# TNS

We Believe in Green Chemistry



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