

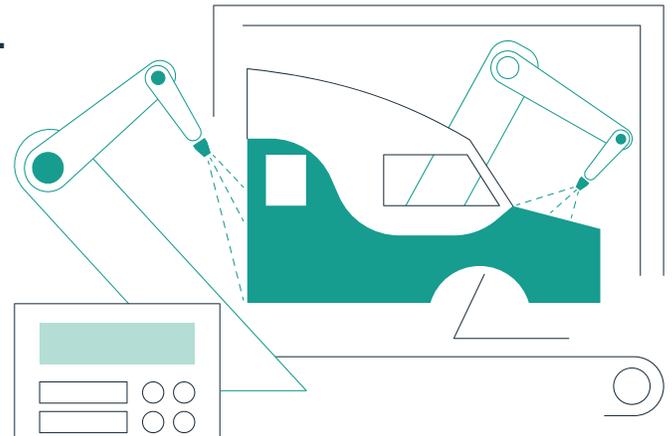
Metal Treatment with Phosphorus Compounds

NON-FERTILIZER USES OF PHOSPHORUS – SERIES

JULY 2025

WHY PHOSPHORUS MATTERS AT THE METAL-SURFACE INTERFACE

The treatment and finishing of metals often rely on phosphorus-based chemicals to enhance their properties, improve durability, and provide aesthetic finishes. These processes play a crucial role in industries ranging from automotive to aerospace. Here, we delve into some common applications of phosphorus compounds in metal treatments.



1. PHOSPHATE CONVERSION COATING

Phosphate conversion coating is a widely used process for steel parts that require corrosion protection or preparation for further finishing, such as painting or lacquering. This process involves immersing steel in a phosphoric acid solution, which deposits a thin, insoluble layer of iron phosphate on the surface.

KEY BENEFITS

CORROSION PROTECTION

The phosphate layer acts as a barrier, reducing the likelihood of rust formation.

PAINT ADHESION

The layer serves as a primer that enhances the adherence of paint or lacquer to the metal surface. This is particularly important in industries like automotive manufacturing, where durable paint finishes are essential.

LUBRICANT COMPATIBILITY

Phosphate coatings improve the retention of lubricants, aiding in the performance of moving metal parts.

Applications include the preparation of steel components like car bodies, industrial machinery, and appliances.



2. ALUMINIUM BRIGHTENING

Aluminum parts often require surface treatments to enhance their appearance and meet design requirements. A process known as aluminum brightening is used to achieve a smooth, shiny finish. This technique involves treating aluminum surfaces with a mixture of phosphoric acid and sulfuric or nitric acid.

PROCESS OVERVIEW

SMOOTHING

The acidic solution removes surface irregularities and oxides, leaving a polished finish.

AESTHETIC ENHANCEMENT

The result is a clean, reflective surface that meets high standards of visual appeal.

This process is commonly used in the production of aluminum components for consumer goods, electronics, and decorative applications.



3. ELECTROLESS NICKEL PLATING

Electroless nickel plating is a sophisticated method for applying a uniform nickel coating on metal and non-metal surfaces. Unlike traditional electroplating, which requires an electrical current, this process employs a chemical reaction facilitated by sodium hypophosphite, a derivative of white phosphorus.

ADVANTAGES

UNIFORM COVERAGE

Unlike electroplating, which struggles to coat recessed areas evenly, electroless plating ensures consistent deposition across complex geometries.

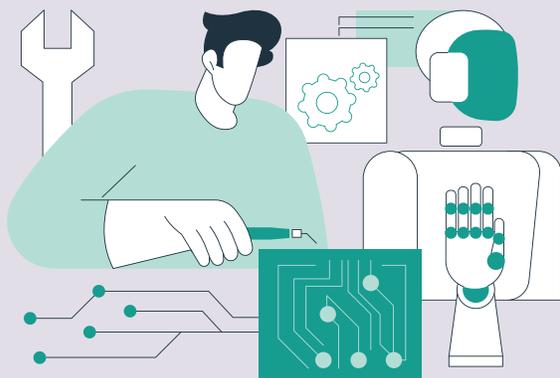
NON-CONDUCTIVE SUBSTRATES

This method can coat non-metallic materials like plastics, expanding its utility in industries like electronics and optics.

CORROSION RESISTANCE

The nickel layer protects the substrate from environmental damage while providing a smooth, shiny finish.

Electroless nickel plating is widely applied in the manufacturing of precision components, electronic devices, and decorative finishes.



REFERENCES

This factsheet is based on insights from the GPI report : **Non-Fertilizer Uses of Phosphorus, an Overview**, prepared by *Willem Schipper Consulting*.

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PHOSPHORIC ACID USAGE IN METAL TREATMENT



The applications described in this factsheet account for a significant portion—20 to 25%—of the total consumption of purified phosphoric acid. Its versatility and effectiveness make it an indispensable component in the metal finishing industry.

CONCLUSION

Phosphorus compounds, particularly phosphoric acid and its derivatives, are essential in the metal treatment industry. They provide critical benefits such as corrosion resistance, aesthetic enhancement, and improved functionality. As manufacturing technologies advance, the demand for these processes is expected to grow, solidifying their role in modern industrial practices.



ABOUT THE GLOBAL PHOSPHORUS INSTITUTE (GPI)

The Global Phosphorus Institute (GPI) is a global organization dedicated to ensuring the responsible use of phosphorus through cutting-edge science and stakeholder dialogue. With a holistic vision and worldwide participation, GPI fosters sustainable practices to advance phosphorus-related technologies and applications.

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