

Stainless steel weaves its web

Stainless steel wire and rod are used to manufacture a wide variety of woven steel mesh products. They are used in many applications ranging from the eye-catching and spectacular to the unobtrusive and utilitarian. Molybdenum contributes to their growing popularity and success by improving corrosion resistance.

Weaving is one of the oldest of human inventions. Over time, it evolved from manual craft methods to highly advanced, automated processes. The materials used have also evolved – from natural textiles such as fibers of plant and animal origin to synthetic polymers and even metals. In this context, it isn't surprising that stainless steel wire has made its way into current weaving processes. It is found in many mesh applications, both spectacular and inconspicuous, but all essential to everyday life. The many crevices formed by overlapping wires in mesh products are ideal sites for crevice corrosion even in relatively mild environments. It is therefore also no surprise that molybdenum-containing stainless steel is the standard

material for such applications since moly improves resistance to corrosion, especially crevice corrosion.

Stainless steel mesh is traditionally used for filtering and screening in a wide range of industries from mining to processing, all the way to high-technology sectors. Architectural applications have emerged more recently but are growing strongly, because stainless steel mesh offers both aesthetic and functional benefits. The common molybdenum grades, Types 316 and 316L are the workhorses, but higher molybdenum grades such as 904L or nickel-based alloys are also used in more aggressive environments.

Weaving techniques borrowed from the textile industry

The weaving of metallic mesh has employed the techniques and vocabulary of the textile industry. Fully automated looms for metal, like cloth looms, employ shuttles, bobbins, and reels. Just as in cloth looms, wires running along the length of the mesh are called the warp; they wrap around stiffer cross wires or rods that are called the weft. Modern looms can weave single fibers less than one micron thick, tufts or strands composed of several braided fibers, cables, or solid wire of various shapes with thicknesses up to 5 mm. Such looms can produce mesh up to 20 meters long and 8 meters wide. Woven mesh is available as flat sheets or in rolls, in either stiff or supple form, depending upon the dimensions of the wire used to manufacture the mesh and the details of the mesh design.

Architectural applications

Stainless steel has long been used in architecture because of its aesthetic appeal and longevity. More recently stainless steel mesh made a strong entry into the market because of its remarkable mix of properties. Mesh products can play multiple roles, providing shading while allowing natural light to enter, ventilation while protecting from the elements, and safety while maintaining a pleasing appearance. Mesh offers the designer countless options for customization of buildings, structures and spaces. In many instances it is selected not only for its visual appeal but also for its contribution to energy-saving and sustainable design. The article on energy-saving stainless [▶](#)



A loom for weaving of stainless steel mesh. © GKD



The architect was able to transform a rectangular building with stainless steel mesh and give it a striking facade. Maison Folie, Lille. © Paul Raftery



Integrated micro-LED lighting systems can create programmed lighting effects for advertising. New York. © GKD/David Joseph

steel facades in the January 2012 issue of MolyReview gives more detail on this subject.

A second “skin” to encase buildings –

A growing trend in modern architecture is to surround buildings in metal mesh to form a “second skin”. The mesh may be applied as rigid flat panels, following the contour of the building, or as flexible mesh modifying its shape. In some cases the “skin” can be used to dramatic effect, for example, in the Maison Folie of Lille, in northern France, where the spiral mesh takes on the appearance of a light veil. But, at the same time, the mesh has the practical purpose of thermal insulation, reducing solar gain and wind cooling, and therefore cutting the building’s energy requirements, while providing a measure of privacy for the tenants.

The specific finish of the mesh (glossy or satin, darker or lighter color) and the ever-changing play of clouds and sun, reflected by the stainless steel mesh, make a building come alive. At night, illumination can generate a transparent, colored or light-dimming effect. The mesh can also be fitted with an integrated

micro-LED lighting system to create programmed lighting effects used, for example, for advertising or for the screening of a movie. Molybdenum containing stainless steel is nearly maintenance-free in these applications due to its high corrosion resistance.

In high-rise parking garages – Mesh allows escape of automotive exhaust gases, and allows sunlight to supplement interior lighting, all the while securing the garage against intrusion and the elements, without leaving a closed-in feeling. Furthermore, woven metal sheets are easy to install. They are simply secured along the perimeter, while solid sheet metal partitions require support and fixing substructures. Carefully thought-out screening on a garage facade can transform the purely utilitarian and generally unsightly aspect of this type of structure to something visually pleasing.

Indoors – mesh from floor to ceiling –

A tight weave that comes in rolls offers a wear-resistant and unusually aesthetic floor covering. Metal mesh partitions divide spaces and provide a sense of privacy without completely closing them

off. Decorative and ornamental meshes can blend steel wires and cables with built-in lighting or exotic materials to create specific ambiances that are highly appreciated by hotel and restaurant designers. On the ceiling, stretched sheets provide good sound insulation and add an interesting decorative element. The fire resistance of stainless steel mesh is another strong point in its favor for architectural use, particularly in public and commercial buildings.

Infrastructure applications –

The Arganzuela walkway, spanning the Manzaranes River in Madrid, designed by French architect Dominique Perrault, uses stainless steel mesh over the length of its double helix structure, serving as guardrails and a screen to protect walkers from the strong summer sun. In addition to these safety and protection functions the mesh’s semi-transparency preserves the elegant design’s airiness. In Norway stainless steel mesh protects users of the Holmenkollen ski-jump featured on the front cover. Over 7,000 m² of Type 316L stainless steel mesh shroud the spectacular flight of steel to protect athletes from the wind and reduce the



Semi-transparent mesh underlines the airy design of this walkway while providing protection from the elements to pedestrians. Arganzuela bridge, Madrid. © IMOA

effects of the cold. By day, the sun's rays play on the metal mesh, while at night illumination creates an impressive ramp of light.

Industrial applications

Architectural applications of stainless steel screening and mesh are only the newest, and perhaps in some ways the most exciting uses of these products. However, mesh has long been used behind the scenes in industrial applications that have underwritten our great technological progress of the last century or more.

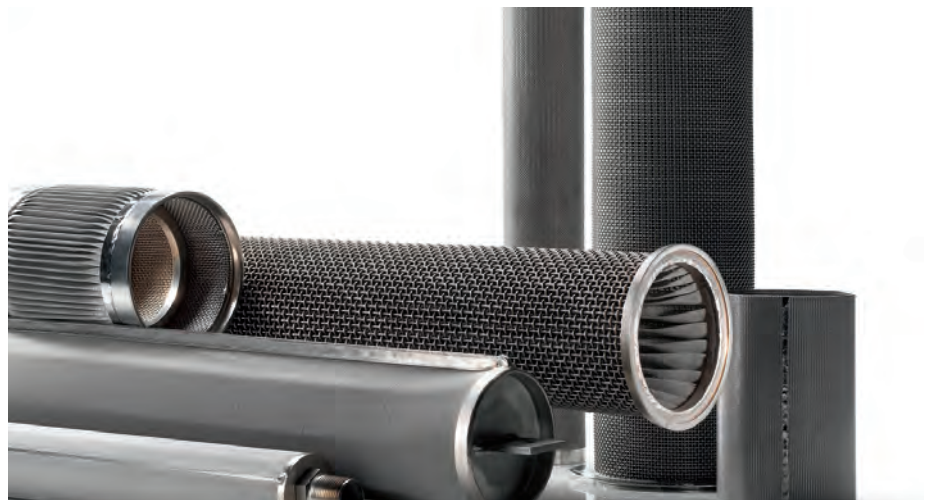
Screening, filtering, and sieving –

These processes separate or remove wet, humid or dry particles from their environment and are widely used in many industries. A perfect illustration of their importance is in molybdenum mining, to use a close-to-home example. Winning molybdenite (MoS_2) from the ore in which it is entrapped requires converting hundreds of millions of tons of large rocks into micron-sized particles. They then have to be further treated to liberate and purify molybdenite so that it can be used in all the products that

support our society today. The process requires many crushing and grinding steps, each of which must also have a screening step to separate smaller particles that can go on to the next step of processing from larger ones that have to go through additional crushing and grinding. The screens used in these steps require materials having high strength, stability to maintain the proper opening size, and in some steps resistance to corrosion from aggressive liquids.

Food, agricultural, pharmaceutical, metallurgical, pulp and paper, chemical and petrochemical processing are other industries that depend on metal filters and screens as do cars, trucks, airplanes and power plants. The wire material depends mainly on the corrosivity of the process. Materials include the austenitic stainless steels Type 316, Type 904L and 6% Mo grades, and the nickel-based alloys Alloy 22 and Alloy 59, the latter for the most corrosive fluids. There are many filter and sieve designs utilizing many different kinds of mesh. Filters can be cylindrical (structured packs), flat, curved or folded. Fine applications such as dye and ink production may employ wire diameters and opening widths as small as 0.02 mm. Coarse screens used in the mining industry can have wire diameters up to 5 mm with opening widths as large as 18 mm. Large or small, industrial screens, filters and sieves rely on molybdenum grade alloys because of their mechanical strength and their corrosion and abrasion resistance.

Belt conveyers – Metal belt conveyers are used in many industrial processes. For instance, they are used for the removal of liquids and moisture from solid waste prior to burning in waste-to-energy plants. These belts must carry heavy loads at elevated temperatures, and be resistant to attack from the cocktail of fluids contained in such waste streams. ➤



A range of Industrial filters with different stainless steel weaves. © GKD

At the other end of the spectrum lie the stainless steel mesh belts used in food processing. The food industry uses these belts extensively because they are easily cleaned, are resistant to aggressive sanitizing, and they work well in high and low temperatures. Food processing belts are used to bake or toast foods at temperatures reaching 200°C; they are also found in liquid-nitrogen spray-freezing tunnels that operate at temperatures as low as -196°C.

Screen-printing mesh – from soda bottles to semiconductors –

Metal mesh is frequently used for screen-printing because mechanical strength and abrasion resistance are essential properties for mesh materials in this process. The mesh must support high tensile stresses arising from the fast passage of the squeegee as it forces the high-viscosity ink through the mesh. For this type of application, Type 316 wires having a diameter of 15 microns are commonly used for the screen’s wefts. Type 316 stainless steel resists the corrosive inks and cleaning solvents that are entrapped in the crevices where warp and weft wires cross. Screen-printing applications range from conventional labeling for pharmaceutical and food bottles to advanced applications required by the semiconductor industry. Here, ultrafine woven metal meshes, for which dimensional accuracy and printing sharpness are imperative, are used to print the masks of printed circuits and mark liquid



A stainless steel belt conveyor runs these bread rolls through the oven and also serves to cool them after. © iStockphoto.com/mujdatuzel

crystal displays and photovoltaic solar panels. Molybdenum-containing stainless steel micromeshes are present in ink jet cartridges where they ensure the fluidity and proper distribution of inks ahead of the jets. Micromeshes made with wire having diameters smaller than one micron may constitute the lower dimensional limit that can be achieved in stainless steel wire meshes.

Summary

Just as woven fabrics evolved from simple natural fibers woven by hand to produce simple items, woven metal mesh

has evolved from simple products using common materials to highly engineered designs that require sophisticated materials solutions for their successful use. Molybdenum-containing stainless steel and other moly-containing alloys solve the problems posed by applications for such new woven products, whether the need is high strength, corrosion resistance, aesthetic properties, or heat resistance. We can expect to see more uses of these sophisticated materials systems as engineers and architects tackle ever more challenging problems and turn to molybdenum containing materials for assistance. (Thierry Pierard)

Chemical composition and applications of stainless steel and nickel-based alloy grades used as mesh

Grade	% C	% N	% Cr	% Ni	% Mo	others	Applications of mesh
AISI 316L	0.02	0.1	17	11	2	–	Architecture, interior design, screen printing
AISI 904L	0.01	–	20	25	4.3	Cu	Architecture, interior design (salt atmosphere)
6% Mo	0.02	0.2	20	18	6.2	Cu	Industrial processes (solvent, corrosive)
Alloy 22	0.01	–	21	Bal.	13	W-Cr	Screening, filtering, sieving, process belts (higher resistance to solvents, acids and chlorine)
Alloy 59	0.01	–	23	Bal.	16	Al	Screening, filtering, sieving, process belts (higher resistance to hydrochloric acids)