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Metal for Roof and Wall in the Agricultural Area

For the production of roof and façade covers, a wide variety of different metals and metal alloys is used. Among the most frequently used metals and alloys are copper, aluminium, steel, stainless steel, and titanium zinc to mention just a few. Among the listed metals, only steel and aluminium in the form of trapezoidal or corrugated iron are used in the agricultural area. Their tendency towards condensate formation must be considered when choosing their areas of application.

Aluminium profile sheets are available from stock from most manufacturers and distributors in thicknesses of 0.5 / 0.6 / 0.7 / 0.8 / 1.00 mm and lengths of up to 18 m. Upon request, greater lengths are available after sufficient previous notice. Generally, aluminium sheets are only coated with paint for aesthetic reasons because aluminium is protected against progressing corrosion by a dense oxide layer.

Wear-resistant coating materials, which remain permanently attached to the galvanization, can significantly prolong the life of the profile sheets. The most common coating materials are polyester (SP), silicone-modified polyester (SI-SP), and polyvinylidene fluoride (PVDF), which forms a layer of 20 to 25 µm, and polyvinyl chloride (PVC),



Fig. 1: Machine for producing trapezoidal corrugated sheets (Photo: Laukien Comp., Kiel)

Profile sheets out of steel are manufactured in sheet thicknesses of 0.63 / 0.75 / 0.88 / 1.00 / 1.25 / 1.50 mm. Like in the case of aluminium, table lengths of up to 18 m are available from stock. Special lengths can also be supplied.

which forms a 100 to 200 µm thick layer. According to our experience, PVC coating (often also called plastisol) is currently the most durable upperside coating. The back side of the sheets generally has a ~ 10 µm thick polyester coating.

Coating

In contrast to aluminium, steel (iron) has an oxide layer which does not protect against corrosion, but rather forms rust together with water. Therefore, the galvanization of steel sheets is indispensable. Smaller damaged areas on the sheet surface are reliably protected by galvanization. For this reason, the cut edges of the sheets do not require extra treatment with corrosion protectants. For galvanized steel sheets not to become grey and unsightly due to the weather, they are coated with coloured paint on the weather side.

Form

Forming exerts a decisive influence on the area of use of profile sheets. In the past, only corrugated sheets were able to be offered for reasons of production technology. In the agricultural area, they only play a role in round silo construction today. In individual cases, round bales with a skin of corrugated iron are also offered.

For profile sheets used as wall- or roof material, the trapezoidal form has meanwhile replaced corrugated sheets. The reason for this development is the greater cost-effectiveness of the trapezoidal form.

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Trapezoidal Corrugated Sheets

are manufactured in different profile heights and forms. Trapezoidal corrugated sheets with low profile heights are used for the production of wall linings. Due to the larger loads, roof covers require higher profiles. The higher the profile is, the less roof substructure is necessary. A trapezoidal corrugated sheet which has a profile height of 160 mm and a thickness of 1.5 mm can extend over 6 m without support, for example.

In principle, trapezoidal corrugated sheets are bolted to the substructure in the deep bead in contrast to corrugated metal sheets and corrugated fibre cement tiles. A washer out of butyl rubber provides a water-tight seal for the bolt connection.

In contrast to aluminium sheets, galvanized steel sheets may in principle not be cut using an angle grinder because this causes the zinc layer to burn. As a result, the cut edges are no longer protected against corrosion.

Condensate

A problem which is common to all sheet metal linings is the condensate problem. The reason for this problem is the physical properties of the metals. The formation of condensate is caused by the following process: the Earth's surface steadily exchanges electromagnetic radiation with the surrounding space. This also includes heat radiation. Whether and to what extent something heats up or cools off is dependent upon the radiation balance.

In the summer around noontime when the sun stands high in the sky, the Earth's surface is heated by the sun. Especially thin sheet metal linings heat up significantly.

On the side of the Earth which faces away from the sun (at night), the balance of radiation exchange is negative, and everything cools off. This is also called deradiation. During particularly clear nights, deradiation is strongest. On such nights, the surface temperatures of roofs in particular may drop up to 6°C below the air temperature. In this case, the temperature falls below the environment-related dew point temperature, and surface condensate in the form of dew water or frost develops.

Due to the high heat conductivity and the low storage capacity of thin aluminium- or steel sheets, identical temperature conditions will develop on the under- and the upper side of the roof at the same time, which causes surface condensate to form on the underside as well. In one hour, up to 500 water drops per square metre can thus form and fall.



Fig. 2: At this pig fattening house cover trapezoidal corrugated sheets were used as facing (Photo: Laukien Comp., Kiel)

In the winter, freezing condensate may develop over a relatively long time without noticeable consequences. When exposed to solar radiation (in particular in the morning), the condensate thaws quickly, and suddenly a larger quantity of water forms.

In the summer, condensate may also develop during the day if it begins to rain in very warm and humid weather. In this case, the temperature may also drop below the environment-related dew point temperature because at our latitudes rain has a maximum temperature of approximately 18°C and the sheet metal covering cools down to about the same temperature.

Remedial Measures

In order to avoid drop formation, industry offers metal sheets which feature anti-drop coating on the underside. Unfortunately, practical experience has shown that anti-drop coating is at best able to a certain extent to prevent the condensate droplets from coalescing into larger drops. It does not have a buffer function like mineral roof plates.

In principle, stalls and storage halls where moisture-sensitive bulk goods are stored should therefore not be covered with metal roof covers. For this reason, fibre cement tiles as a roof cover are the best choice for most farm buildings.

Only heat-insulated sandwich elements (also called insulating panels) are exempt from the dew water problem because the underside of the plate is thermally de-coupled from the upper side by the insulating layer situated in between. These elements are offered with insulating material layers ranging

from 20 mm to 200 mm in thickness. In the agricultural area, insulating panels are mainly used for the construction of cooling houses and temperature-controlled stores for vegetables and potatoes. For cost reasons, they cannot be considered for stall construction in most cases.

Wall Linings

out of steel- or aluminium profile sheets are an inexpensive, low-maintenance alternative to other wall construction materials, such as brick or wood. Condensate formation is no problem. If the wall is designed properly, condensate may flow off without damaging the interior of the building. In addition, surrounding buildings or plants often result in wall areas being less affected by nightly deradiation than roof areas.

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