# WHY ARE THERMAL SCREENS INDISPENSABLE FOR GREENHOUSES

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Thermal screens fulfill the task of creating inside greenhouses an adequate microclimate for the plants in order to increase their yield, and also to improve their quality.

a) The factors influencing a greenhouse microclimate are: the external climate conditions, the topography of the area, the structure of the greenhouse itself, its type of covering, volume and roof height, the coverage of the terrain below the foliage of the plants, as well as some other diverse factors.

b) The screen or net represents one of the elements of the climate control system. Other of its components are the aeration (natural or artificial), the humidity increase level (by means of wet soil beds or sprinklers), and its heating (by hot air or radiation).

The climate control system constitutes a tool at the farmer's disposal, who must know the conditions set forth in paragraph (a) above, and use wisely the means at his disposal under paragraph (b) in order to create the appropriate micro-climate conditions for his plants.

**Reflective Shading Screen**

During the day, solar radiation penetrates the greenhouse through its covering, and heats the plants and the rest of the internal elements, all of which heat the air inside the greenhouse in turn. The reflective shading net is installed on the roof of the greenhouse in order to interpose it between the solar radiation and the plants. The radiation is reflected up and outwards, thus reducing the inner temperature at the greenhouse. The combination of reflective shading screens and an adequate aeration facilitates the control of the inner temperature, and serves as well as regulator of the relative humidity inside the structure.

**Thermal Screen**

During the night it is necessary to store the energy created by the accumulated heated air within the greenhouse by the heating system during the day. The hot air filters outside through openings and slots, or rises up to the roof and from there passes outside through the covering material.

The infrared radiation issued by the different elements, the plants and the soil affect the greenhouse roofing, ultimately influencing radiation or its filtration upwards. A thermal screen that contains reflecting components fulfills also its task as a barrier against infrared radiation. At the same time, as in a mirror, the screen sends the heat of the infrared rays both to the plants and to the other elements inside the greenhouse. The thermal screens allow the reduction of the energy costs required by the necessary heating. The main factors influencing the increase of relative humidity inside the hothouse are the evaporation by the plants themselves and the decrease of the temperature of the air inside.

***Open Sealed Screens: Their influence on the Micro-Climate During the Night***

**Aluminum Fiber Thermal Sealed Screen (ALUMINET)**

**Introduction**

In plant growing hothouses, the function of the thermal screens is to facilitate the farmer's creation of an adequate microclimate in order to boost yield and to improve the quality of his products.

The screen is only one of the elements that conform a climate control system for the crops.

The sealed or closed screen is most adequate for winter climate conditions, and has been designed fundamentally to reduce heat loss within the greenhouse. The energy savings during artificial heating are significant, due to the fact that reflective material strips are woven within the screen.

***a) Thermal screens for winter energy savings within the greenhouse***

The main contribution of the sealed or weathertight screen is to keep the heat within the hothouse. The screen hinders the heated air transfer from the plants' vicinity to the roof and additionally, the infrared radiation returns to the plants and maintains their temperature. In a heating system by means of water, the higher the shading level is, the higher the screen's efficiency in maintaining the heating will be. No water condensation is generated in the lower

sector of the screen because it “breathes”. The aluminum fiber weathertight screen (ALUMINET) is therefore the most adequate for energy saving.

***b) Shading screens for reducing greenhouse heat load during the summer***

The sealed screens are used in order to optimize the greenhouse inner microclimate. When solar radiation is intense the screen avoids the damage to the plants by direct radiation, and prevents the accumulation of calorific energy by the soil and dark-colored elements. As a result, the temperature inside the hothouse will decrease, the relative humidity will intensify, and consequently, the combination of both these factors will improve the climate conditions within the structure. The association of an aluminum fiber weathertight screen with means for artificially increasing humidity allows to effectively control temperature and humidity during daylight hours.

***c) Diffuse light penetration***

The transparent strips of the screen allow direct sunlight to get in, while the reflective ones return the light reflecting on them from the inside of the greenhouse back to the plants. For instance, a 60% hermetic screen allows the passage of 40% of direct sunlight, but only 50% of the diffuse light, all of which remains inside to be used for the photosynthetic process.

**Open-woven Aluminum Screen (ALUMINET)**

**Introduction**

In plant-growing hothouses, the thermal screen function is to facilitate the farmer’s creation of an adequate microclimate in order to boost yield and to improve the quality of his products.

The screen is only one of the elements that conform a climate control system for the crops.

The open-woven screen is the most adequate for cold climate conditions in winter and harsh heat during summers, as in Israel. Therefore, this screen is used mainly for the heat load reduction inside greenhouses. The reflective material with which the aluminum net is manufactured (ALUMINET) contributes to energy savings for greenhouse heating in winter.

***a) Shading screens for reducing the greenhouse heat load during the summer***

In hothouses provided with roof openings, the open-woven screen allows the heated air rising from the plants to reach the roof and come outside. In a greenhouse equipped with a sprinkler system or wet beds in order to increase humidity, the heated air passes through the screen, allowing humid and cool air running beneath it to reach the plants. Even in the case of eventual malfunctions in the humidity boosting system, no condensation will be observed on the screen.

***b) Thermal screens for summer energy savings within the greenhouse***

The principal contribution of the open-woven screen as to heat conservation inside the greenhouse is linked to its reflectivity. The open screen retains the infrared radiation

and returns it to the plants, thus conserving the heat they require. The efficiency of the screen is higher if employed with a heating system using water instead of an air heating one. The higher the density of the fabric (depending on its shading level), higher the efficiency of the screen will be in keeping the heat inside. Below an open-woven screen there is no condensation, and therefore the farmer is safe from the dangers of entry or diffusion of fungal diseases on the plants' leaves. For this reason it is not necessary to open the screens at any given periods in order to free the humidity surplus. The open-woven screens can be left in place the whole night without the risk of excessive humidity.

***c) Diffuse Light Penetration***

An open-woven screen is a net woven with the inclusion of brilliant reflective fibers. The light they receive from the outside hits those fibers, passes through them and is diffuse around the plants. The diffuse light thus received contributes to the photosynthetic process, and gives less heat than the direct sunlight radiation. For instance: a 60% open-woven net allows the passage of 40% of direct light and another 15% of diffuse light, as compared to the 60% black shading net, which only allows the passage of 40% of direct light.

The subject of diffuse light deserves to be taken into account whenever the shading rate of an open screen has to be decided, because the light required by the plants includes not only the direct sunlight, but also the diffuse light. An open screen that tolerates the efficient passage of diffuse light, allows a higher shading rate than the one obtained by means of a closed, sealed screen. This undoubtedly increases the effectiveness of the open screen with respect to energy savings.