

www.koolancel.com



**Greenhouse
Catalogue**





“KOOLANCEL” company was established in 2008 as the first manufacturer of cellulose pads in the Middle East. In 2010, “KOOLANCEL” Company joined as a member of ENERGY Holding. The result of this partnership and cooperation has been the increasing development and becoming the largest manufacturer of cellulose pads in the Middle East.

In 2017, KOOLANCEL Company developed the brand “NADPOLYMER” to manufacture unsaturated polyester, phenolic and acrylic resins per the customers’ needs.

KOOLANCEL’s approach has always been to manufacture high-quality products in line with the customers’ needs and provide a superior value proposition. KOOLANCEL is the pioneer of the evaporative cooling industry for various applications in Iran.

Geat weather, Great vibes ...

Koolancel Company (Public J.S.C.)

Evolution Of KOOLANCEL



01

2005

Business plan development



02

2008

Obtaining the operating license



03

2009

Expanding the scope of activity to the HVAC industry and gas inlet air cooling



04

2010

Membership in ENERGY Holding



05

2012

Development of the factory



06

2016

Starting to export
cellulose pads

07

2017

Starting to
manufacture
industrial resins with
“NADPOLYMER”
brand

08

2020

Starting to
export
cellulose pads
to Europe

09

2022

Starting to
export
cellulose pads
to the UAE

10

2023

Starting to
manufacture
galvanized steel
and
aluminium
frames

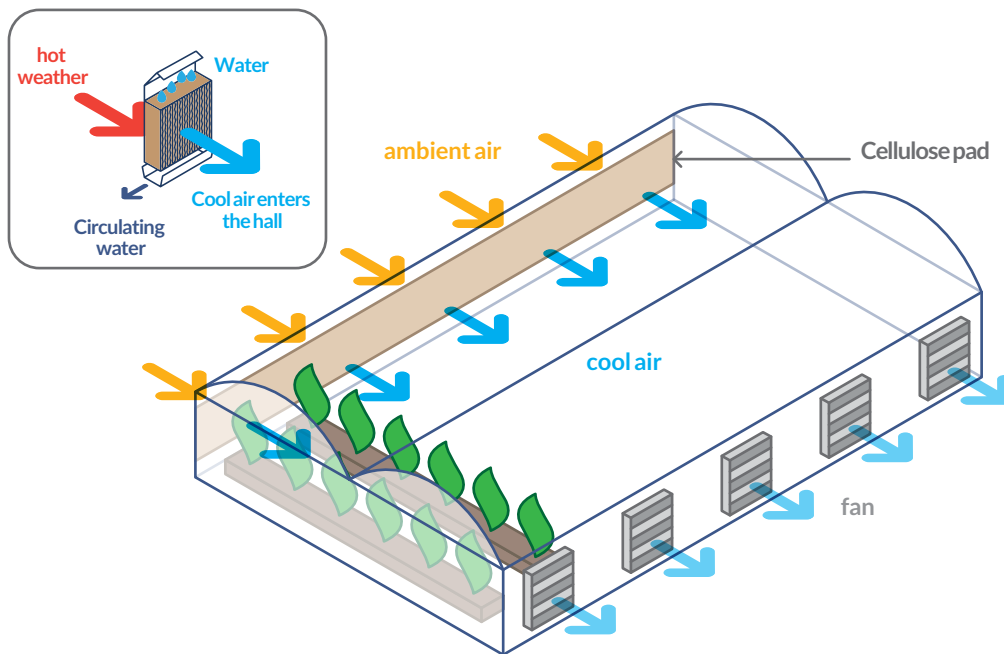
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2026

IPO on
Iran Fara Bourse

Evaporative Cooling

Evaporative cooling is the easiest and most efficient way to create cooling. Our body rejects heat using the same method and through sweating (moisture evaporation from the skin). Evaporative coolers use different evaporative media to cool the air, of which the cellulose pad is one of the most efficient. (Figure 1)



(Figure 1) Fan and Cooling pad in greenhouse

The cellulose pad consists of regular and fluted thin sheets with high wettability and water absorption properties and is saturated by chemical materials to increase strength and durability. The uniform and dense structure of the pad causes the air–water interface in the cellulose pad to be more significant compared to the aspen pad and the airspeed to be more uniform.

These factors increase the cooling rate and prevent the entry of water droplets, dust and harmful respiratory bacteria into the airflow.



Principles Of Cooling And Ventilation Of Greenhouses

Ventilation and cooling of the greenhouse is necessary to provide a favorable environment for plant growth.

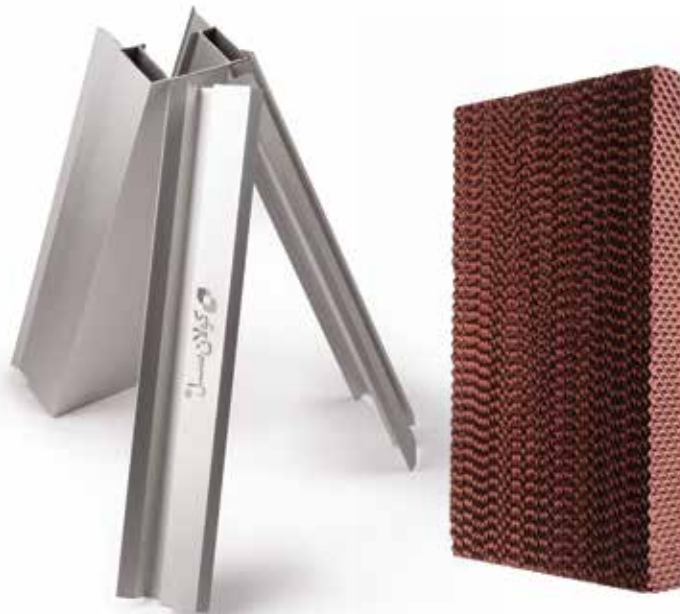
Evaporative cooling pad adds moisture to the greenhouse air that reduces plant transpiration and the required water for irrigation. Moreover, dust, insects and airborne particles are trapped by the pad.

The greenhouse is ventilated for the following reasons:

- 1– It prevents the greenhouse temperature from rising too much during the day;**
- 2– Ensuring the proper level of greenhouse carbon dioxide;**
- 3– Greenhouse humidity control.**

KOOLANCEL Solutions

KOOLANCEL specializes in evaporative cooling for greenhouses, producing various types of cellulose cooling pads with different features as evaporative media. The brand also manufactures standard frames made from galvanized steel and aluminum, which are designed to supply water and provide drainage to moisten the walls of the cellulose pads in evaporative cooling systems.



KOOLANCEL's Cellulose Pads Advantages

Long Lifetime

KOOLANCEL is the only company manufacturing cellulose pads in Iran, which provides **up to 36 month guarantee** against deformation and pulping.

More Cooling

- Higher cooling efficiency than other pads available in the market
- Providing sales engineering services to manufacture the optimal results.

Export To Europe

KOOLANCEL Company has exported its products to different countries due to its deep knowledge and manufacturing the products that meet global standards. It is also the only exporter of cellulose pads from Iran to Europe.

Scandinavian Virgin Paper

Papers used in KOOLANCEL's cellulose pads are directly imported from Northern European countries. Due to the better raw materials, KOOLANCEL's cellulose pads have higher wettability and water absorption properties.

Fast Delivery

On-time Order Delivery

The Only Professional Manufacturer Of Cellulose Pad Resins In Iran

In recent years, KOOLANCEL Company, relying on the knowledge of Iranian experts, has taken steps towards the production of specialized resins for cellulose pad and has been able to supply top-quality products.

KOOLANCEL's Frame Advantages

- **State-of-the-art engineering design;**

- **Uniform water distribution;**

Enhances efficiency and extends the service life of the pad.

- **High water storage capacity;**

The design of the lower gutter, results in a large water storage volume, reducing the number of water drains.

- **Easy and precise installation;**

- **Easy inspection and maintenance;**

The water distribution pipe is easily visible and accessible for inspection and maintenance.

- **Highly robust with appropriate thickness.**



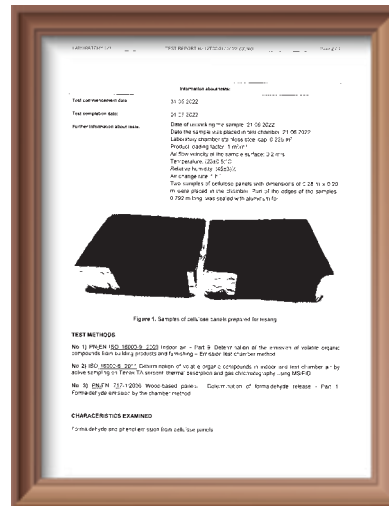
Testing The Qualitative Indices Of The Cellulose Pads In Accordance With The European Union Standard.

Cellulose pads of KOOLANCEL were investigated to evaluate the qualitative indicators in one of the accredited laboratories of the European Union, and the following results were obtained;

- The amount of free phenol in 72 hours was less than one microgram per cubic meter;
- The amount of free formaldehyde has been determined by performing tests in different intervals, which has stabilized at less than 0.002 mg/m³;
- The amount of free phenol and formaldehyde in KOOLANCEL's cellulose pads was within the standard range and had the standards required in the European Union.

Note: In the home appliance industry, the quality indicators of cellulose pads are more sensitive than other industries such as poultry and greenhouse, so having these quality indicators indicates the high quality of the products.

KOOLANCEL is the first Iranian company to receive this certificate successfully.

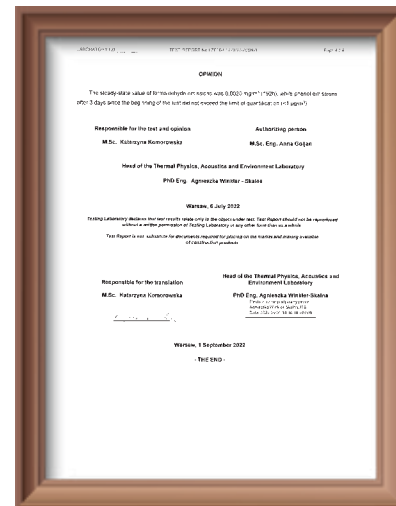


TEST RESULTS

Table 1. Formicdehyde and phenol concentration in the air of the chamber containing samples of cellulose pads.

Sampling date	Time after installation of samples in the test chamber (h)	Formicdehyde concentration (ppm)	Phenol concentration (ppm)
21.06.2022	24	0.0065 ± 0.0024	0.0065 ± 0.0024
22.06.2022	24	0.0065 ± 0.0024	0.0065 ± 0.0024
23.06.2022	48	0.0065 ± 0.0024	0.0065 ± 0.0024
24.06.2022	72	0.0065 ± 0.0024	0.0065 ± 0.0024
27.06.2022	120	0.0065 ± 0.0024	0.0065 ± 0.0024
28.06.2022	144	0.0065 ± 0.0024	0.0065 ± 0.0024
29.06.2022	168	0.0065 ± 0.0024	0.0065 ± 0.0024
30.06.2022	192	0.0065 ± 0.0024	0.0065 ± 0.0024
01.07.2022	216	0.0065 ± 0.0024	0.0065 ± 0.0024
08.07.2022	72	0.0065 ± 0.0024	0.0065 ± 0.0024

The test results show that the concentration of formicdehyde and phenol in the air of the chamber is within the limits of the European Standards.



Factors Influencing the Performance and Application of Cellulose Pads:

1. Flute Height:

Flute height is a key factor affecting both the saturation efficiency and pressure drop in cellulose pads. These two factors are considered the primary criteria for evaluating pad quality and performance. For the naming system of KOOLANCEL pads, the first two digits indicate the flute height. For example: KOOLANCEL 4090 Series Cellulose Pad: Flute height is 4 mm.



As the flute height increases in cellulose pads, the number of layers (sheets), and consequently the structural density, decreases. This reduction in density leads to a smaller contact area between the airflow and the wet surface of the pad, thereby reducing evaporative efficiency and cooling performance. On the other hand, increasing the flute height creates wider air channels, which results in less resistance to airflow. This, in turn, leads to a lower system pressure drop.

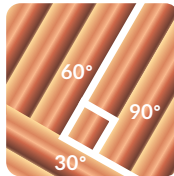
Therefore, the lower the flute height of the cellulose pad, the higher the cooling efficiency and the greater the pressure drop. Conversely, as the flute height increases, efficiency decreases and the pressure drop is reduced.

Note: The appropriate flute height should be selected as per system requirements (e.g., high cooling efficiency or low pressure drop) and operational conditions.

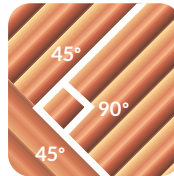
2. Corrugation Angle Configuration in KOOLANCEL Cellulose Pads:

In various series of KOOLANCEL cellulose pads, the angle between the corrugation directions of adjacent paper sheets differs. For example, in series 7090 or 7060, the corrugation directions of two adjacent sheets form angles of 90 and 60 degrees with each other, respectively. In the 90-degree corrugation configuration used in KOOLANCEL cellulose pads, there are two different structural arrangements:

1. 30/60 Configuration: Alternating arrangement of sheets with corrugation angles of 30 and 60 degrees.
2. 45/45 Configuration: Sequential arrangement of sheets, all with a corrugation angle of 45 degrees.



(30/60) Configuration



(45/45) Configuration

In The Following Section, We Will Examine The Differences Between Each Of These Configurations:

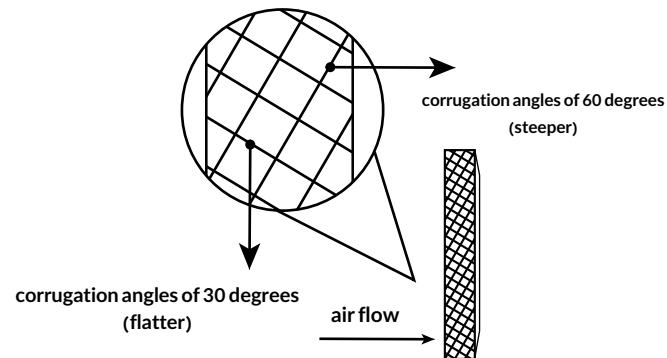
A. Air Flow Direction

Pad with 45/45 Configuration

The incoming airflow can enter from both sides of the pad.

Pad with 30/60 Configuration

To achieve optimal performance, the 60 degree angle should face the air intake side.



B. Water Droplet Carryover

Pad with 45/45 Configuration

Due to the symmetric 45-degree angle, the 45/45 pad tends to have higher carryover.

Pad with 30/60 Configuration

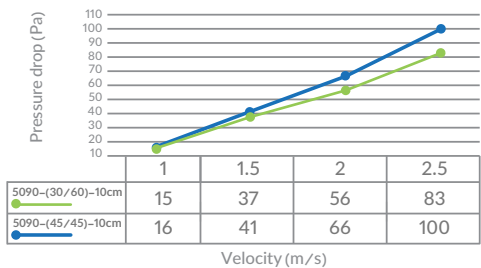
Due to the steeper 60-degree angle on one side of the pad, more water flows toward the air inlet. As a result, this configuration exhibits lower carryover.

C. Pressuræ Drop

- The pressure drop across the pad with a 30/60 configuration is lower compared to the 45/45 configuration.

This lower pressure drop is due to the reduced resistance to airflow created by the 30-degree wave angle.

Suitable for cooling systems capable of handling moderate pressure drop.

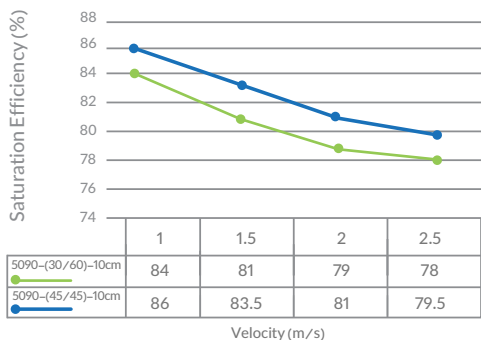


D. Saturation Efficiency

- The efficiency of the 45/45 pad is higher than that of the 30/60 configuration.

The reason for this higher efficiency is the longer air passage channels in this type of pad.

A longer channel increases both the contact time and surface area between the air and the water-saturated pad, thereby enhancing heat transfer and cooling performance.



E. Applications

Cellulose Pad with the configuration 45/45

(Maximum Cooling Efficiency and Moderate Pressure Drop)

- Provides the highest evaporation efficiency and therefore the greatest cooling capacity.
- Suitable for cooling systems capable of handling moderate pressure drop.

Cellulose Pad 30/60

(Adequate Cooling Efficiency and Minimal Pressure Drop)

- Suitable for applications with high air exchange rates or cooling systems with high volumetric airflow.
- No water droplet carry-over even at high air velocities.
- The 5090 pad with a 30/60 angle, due to its higher evaporation efficiency compared to the 7090 pad with a 45/45 angle and nearly equal pressure drop, can serve as a substitute in greenhouses, poultry houses, and also in portable evaporative coolers with axial fans.

3. Thickness of the Cellulose Pad:

In various series of cellulose pads, as thickness increases, both efficiency and pressure drop increase. The rise in efficiency is due to the greater contact surface area between the passing air and the wet cellulose pad. The increased pressure drop, on the other hand, results from the longer airflow channels in thicker pads.

4. Paper Material:

Kraft paper is the primary raw material used in the production of cellulose pads, and undoubtedly the quality of this material directly impacts the quality of the final product. The quality of the kraft paper affects water absorption and capillarity, both of which play a crucial role in the efficiency of the final product.

5. Resin Quality:

Various types of resins are used both as a coating and as an adhesive in the production of cellulose pads. High-quality resins increase the durability and service life of the pads. KOOLANCELL cellulose pads are manufactured using high-grade NadPolymer-manufactured resins and are offered with **Up to 36 month guarantee** against deformation and pulping.



KOOLANCEL Cellulose Pad Products Series

KOOLANCEL manufactures a variety of cellulose pads for various applications, including evaporative coolers, greenhouses, poultry houses, power plants and data centers. KOOLANCEL brand, due to superior-quality products, has gained a unique position in customers' mind. The product series of KOOLANCEL cellulose pads are presented in the table below.

Series	Configuration	Applications
4090	(45/45)	Evaporative coolers
5090	(45/45)	
6090	(45/45)	
7090	(45/45)	Greenhouses Poultry houses Data centers
	(30/60)	
5090	(30/60)	
8090	(45/45)	
7060	(45/15)	
7060	(45/15)	Power Plants

Table 1: All Types Of Koolancel Cooling Pads Series

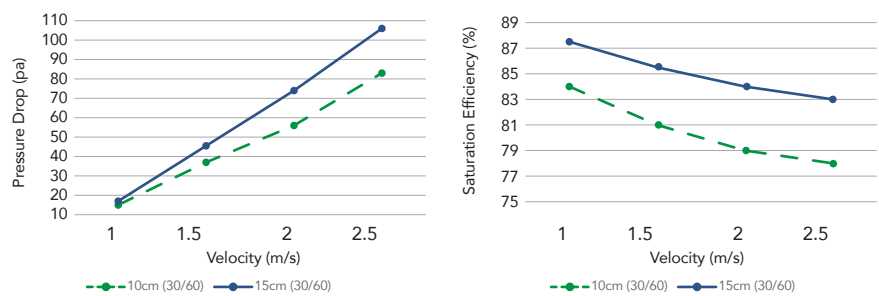
Information Greenhouse Series	Height (cm)	Width (cm)	Thickness (cm)
5090 (30/60) 7090 (45/45) 7090 (30/60) 8090 (45/45) 7060 (45/15)	200	60	10-15
	180	60	10-15
	150	60	10-15
	120	60	10-15
	100	60	10-15

Table 2: The Dimensions Of Common Greenhouse Series

Series And Dimensions Of Cooling Pads In The Greenhouse

5090 Series

In the 5090 series, fluted cellulose sheets with a flute height of 5 mm are placed on top of each other, and the corrugation direction of the two adjacent sheets form an angle of 90 degrees (30/60) to each other (Figure 2). The 5090 series with configuration (30/60), due to its higher saturation efficiency compared to the 7090 series with configuration (45/45) and nearly equal pressure drop, can serve as a replacement in greenhouses, poultry houses, and also in portable evaporative coolers with axial fans.



Saturation efficiency and Praessure drop diagram 5090 (30/60) series

5090 Series With (30/60) Configuration	
Nominal Saturation Efficiency	81%
Nominal Pressure Drops	37 Pa
Number Of Corrugated Sheets In Unit Length (1 m)	190
Density	33/44 Kg/m ³
Water Absorption	140%

Table 3: Nominal saturation efficiency and pressure drop are calculated at 1.5 m/s air velocity for a 10 cm thick pad.

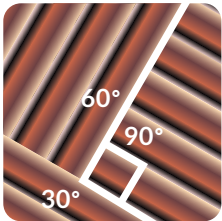
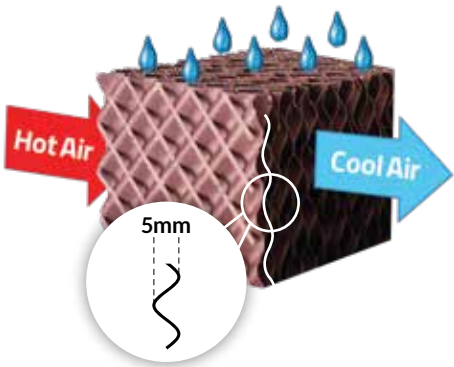


Figure 2: (30/60) Configuration



Series And Dimensions Of Cooling Pads In The Greenhouse

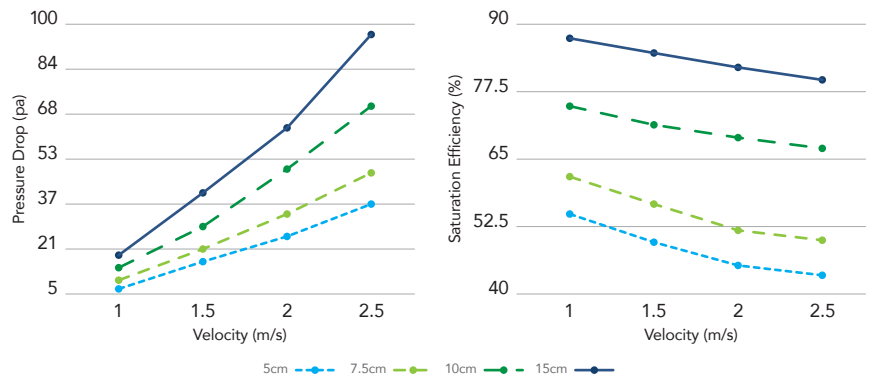
7090 series

In the 7090 series, wavy cellulose sheets with a flute height of 7 mm are placed on top of each other, and the corrugation direction of the two adjacent sheets forms an angle of 90 degrees (45/45) to each other (Figure 3).

These series are specifically used in the walls of greenhouses and poultry farms along with the frame set, water supply system (tank, pump, and pipe) and fan.

The configuration (30/60) of this series is suitable for applications requiring low pressure drop or high air exchange rates.

Considering the lower saturation efficiency of the configuration (30/60) compared to the configuration (45/45), The use of it is recommended in greater thicknesses.

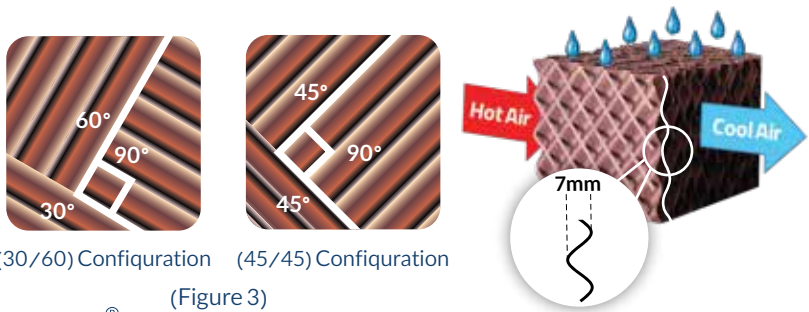


Saturation efficiency and Praessure drop diagram 7090 (45/45) series

These series are offered in different dimensions according to the customer's order and based on the required cooling capacity. It is also possible to provide these series with a water distributor. These series is offered in different dimensions according to the customer's order and based on the required cooling capacity. It is also possible to provide these series with a water distributor.

7090 Series With (45/45) Configuration	
Nominal Saturation Efficiency	71%
Nominal Pressure Drops	29 Pa
Number Of Corrugated Sheets In Unit Length (1 m)	143
Density	23/66 Kg/m ³
Water Absorption	140%

Table 4: Nominal saturation efficiency and pressure drop are calculated at 1.5 m/s air velocity for a 10 cm thick pad.



7090 Series With (30/60) Configuration

Nominal Saturation Efficiency

64.5%

Nominal Pressure Drops

16.9 Pa

Number Of Corrugated Sheets
In Unit Length (1 m)

143

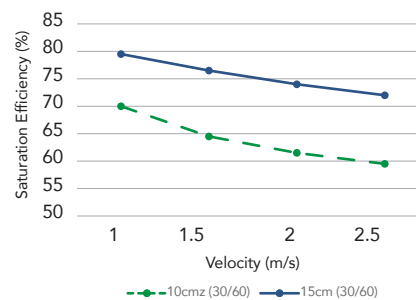
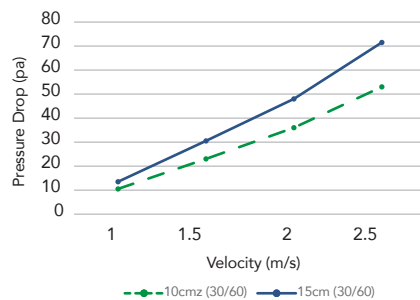
Density

23/66 Kg/m³

Water Absorption

140%

Table 5: Nominal saturation efficiency and pressure drop are calculated at 1.5 m/s air velocity for a 10 cm thick pad.



Saturation efficiency and Pressure drop diagram 7090 (30/60) series

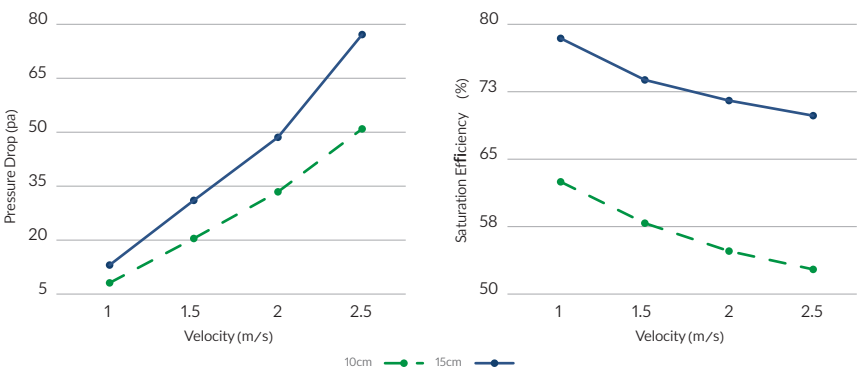


Series And Dimensions Of Cooling Pads In The Greenhouse

8090 series

In the 8090 series, wavy cellulose sheets with a flute height of 8 mm are placed on top of each other, and the corrugation direction of the two adjacent sheets constitutes an angle of 90 degrees (45/45) to each other (Figure 4). These series are specifically used in the walls of greenhouses and poultry farms along with the frame set, water supply system (tank, pump, and pipe) and fan.

The elevated flute height of this series diminishes the likelihood of pad openings becoming blocked, making it a suitable option for regions with high water hardness and no available means to soften and purify the water. Given its lower saturation efficiency compared to the 8090



Saturation efficiency and Praessure drop diagram 8090 (45/45) series

series, it is advisable to employ thicker pad when using this series. These series are offered in different dimensions according to the customer's order and based on the required cooling capacity. It is also possible to provide these series with a water distributor.

8090 Series With (45/45) Configuration	
Nominal Saturation Efficiency	74%
Nominal Pressure Drops	31 Pa
Number Of Corrugated Sheets In Unit Length (1 m)	125
Density	21/70 Kg/m ³
Water Absorption	140%

Table 6: Nominal saturation efficiency and pressure drop are calculated at 1.5 m/s air velocity for a 10 cm thick pad.

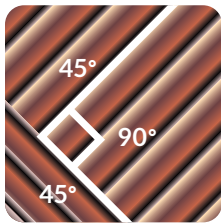
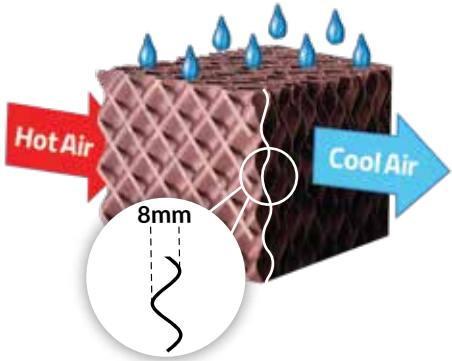


Figure 4: (45/45) Configuration

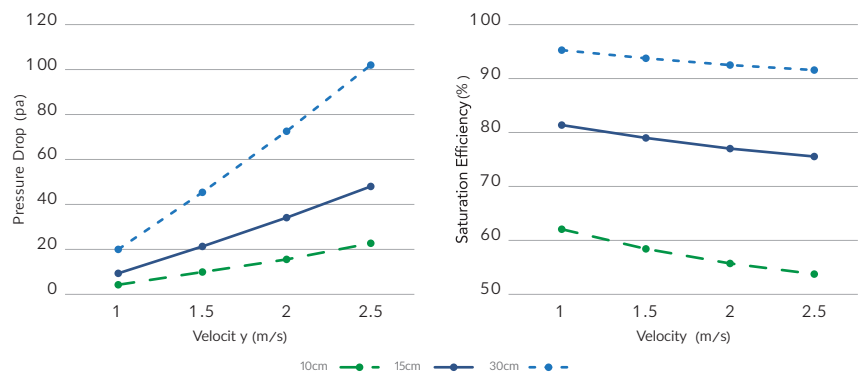


Series And Dimensions Of Cooling Pads In The Greenhouse

7060 series

In the 7060 series, wavy cellulose sheets with a flute height of 7 mm are placed on top of each other, and the corrugation direction of the two adjacent sheets constitutes an angle of 60 degrees (45/15) to each other (Figure 5).

Because of its minimal pressure drop, this series is well-suited for applications that involve a high ventilation rate or airflow through the pad. Given the lower saturation efficiency of this series compared to the 7090 series, it is recommended to use thicker pad when employing this series.



Saturation efficiency and Pressure drop diagram 7060 (45/15) series

These series are offered in different dimensions according to the customer's order and based on the required cooling capacity. It is also possible to provide these series with a water distributor.

7060 Series With (45/15) Configuration	
Nominal Saturation Efficiency	79%
Nominal Pressure Drops	22 Pa
Number Of Corrugated Sheets In Unit Length (1 m)	143
Density	22/66 Kg/m ³
Water Absorption	140%

Table 7: Nominal saturation efficiency and pressure drop are calculated at 1.5 m/s air velocity for a 10 cm thick pad.

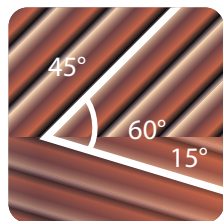
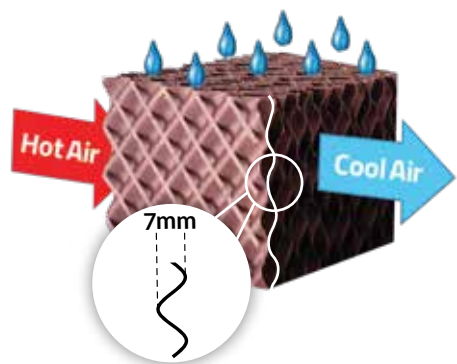


Figure 5: (45/15) Configuration



(Figure 5)

KOOLANCEL Cellulose Pads And Frames Features

Evaporative cooling using cellulose pads is considered the most effective and widely-used cooling method.

The advantages of using KOOLANCEL cellulose pads in greenhouses include:

- High strength and durability (36 months guarantee against deformation and rotting);
- High cooling efficiency (up to 30% more than aspen pad during the season);
- Longer life time; (4 to 6 times longer than aspen pad);
- Higher wetting properties and water absorption due to better raw materials;
- Low scaling due to self-cleaning;
- Removal of dust and insects;
- Less fungus and algae growth, and no transmission of harmful respiratory bacteria.

Aluminium Frame features:

- Anodized aluminium with a higher corrosion resistance;
- Highly robust and lightweight;
- Recyclable and environment-friendly.

Colored Galvanized Steel Frame features:

- Enviroment-friendly (non-absorbent by humans and the enviroment)
- Hot-dip galvanized;
- Eye-catching organic color coating;
- 3 to 5 times increased corrosion resistance in the Salt Spray Test compared to regular galvanization. Toc coating provides heightened corrosion resistance.



To ensure proper ventilation and cooling of the greenhouse, the following recommendations should be observed:

- **The area of ceiling and wall vents should be at least 15–20% of the greenhouse floor area.**
- **To evenly distribute airflow, the distance between fans should not exceed 25 feet (7.62 meters).**
- **To minimize temperature differences and achieve optimal cooling, the distance between the pad and the fan should range from 100 to 225 feet (30 to 69 meters).**
- **The minimum distance between the fan and any obstacle in front of it should be greater than 1/5 of the fan's diameter.**
- **The typical temperature difference between the air exiting the pad and entering the fan is 4 to 5.5 degrees Celsius (7 to 10 degrees Fahrenheit).**
- **The distance between the moist air exiting the fan of one greenhouse and the cooling pad of an adjacent greenhouse should be at least 50 feet (15.24 meters).**
- **The PH of the circulating water should be maintained between 6 and 9.**

Sales engineering services

The amount of ventilation depends on factors such as sunlight intensity, altitude, and the distance between the air inlet and the fan. However, for a general estimate, you can refer to Table 8 to determine the required ventilation.

Note: Exact ventilation calculations should consider all influencing factors and be conducted by qualified experts.

Seasons	The amount of ventilation for the distance between the air inlet and the fan is more than 100 ft	The amount of ventilation for the distance between the air inlet and the fan is less than 100 ft
Summer	$12 \frac{(\text{cfm})}{\text{Ft}^2}$	$\frac{12.10}{\sqrt{\mathbf{D}}} \frac{(\text{cfm})}{\text{Ft}^2}$
Winter	$2 \frac{(\text{cfm})}{\text{Ft}^2}$	$\frac{2.10}{\sqrt{\mathbf{D}}} \frac{(\text{cfm})}{\text{Ft}^2}$
D is the distance between the air inlet and the fan in ft.		

Table 8: The amount of ventilation required for the greenhouse hall

Once the required ventilation is determined, the surface area of the necessary cooling pad can be calculated using Table 9. This table also allows you to determine the required circulating water flow rate, the capacity of the water storage tank, and the appropriate water discharge rate to prevent sediment buildup on the pads.

Descriptions	10 cm thick		15 cm thick	
Face Air Velocity (fpm)	250		350	
Circulating water Flow rate (gpm/ft)	0,5		0,8	
Tank Volume (gal/ft2)	0,8		1, 0	
Water distribution pipe diameter (in) (The distance between the water distribution holes is 3 inches and their diameter is 3 mm)	Up to 50 feet	50 -60 feet	Up to 30 feet	30 -50 feet
	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$
Water bleed-off rate (%)	1 -2		1 -2	

Table 9: Specifications of the cooling system for pads with a thickness of 10 and 15 cm

For precise calculations of cooling pads, frames, fans, and other equipment for your greenhouse, please contact the KOOLANCEL company sales engineering team at +9826 34055145.

Example

Consider a greenhouse that is 120 feet (36/576 m) long, 90 feet (27/432 m) wide, and 14 feet (4/2672 m) high, as illustrated in the figure below. The required ventilation and pad surface area needed to cool this greenhouse are calculated as follows:
(Note: 1 foot = 0.3048 m)

Greenhouse= $120 \text{ ft} \times 90 \text{ ft} = 10,800 \text{ ft}^2$ (1,003.3 m²)

The Ventilation Rate Required in Summer= $10,800 \text{ ft} \times 12 \text{ cfm/ft}^2 = 129,600 \text{ cfm}$

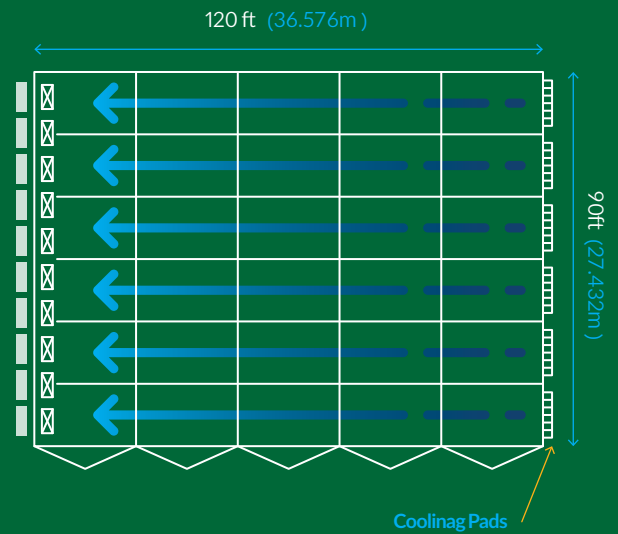
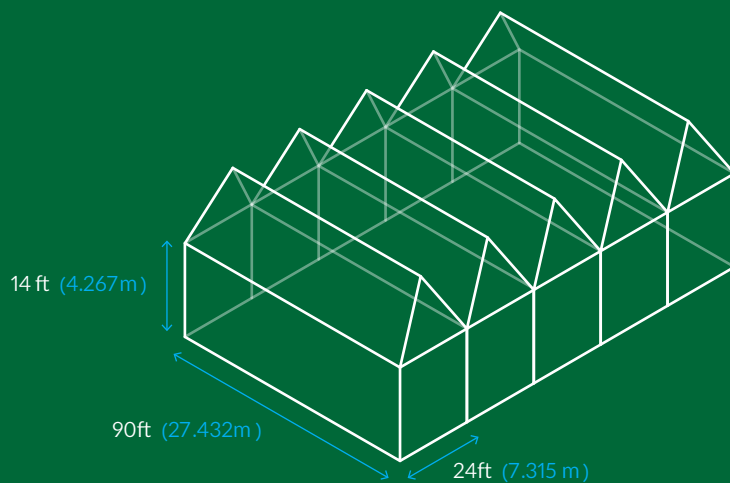
The Ventilation Rate Required In Winter= $10,800 \text{ ft} \times 2 \text{ cfm/ft}^2 = 21,600 \text{ cfm}$

The Area Of The Pad Required With The Thickness Of 10 Cm= $129,600 \text{ cfm} \div 250 \text{ fpm} = 518 \text{ ft}^2$ (48.124 m²)

Pad Height= $518 \text{ ft}^2 \div 90 \text{ ft} \approx 6 \text{ ft}$ (1.83 m)

Circulating Water Flow Rate= $90 \text{ ft} \times 0.5 \text{ gpm/ft} = 45 \text{ gpm}$

The Volume Of The Water Storage Tank= $(6 \times 90) \text{ ft}^2 \times 0.8 \text{ gal/ft}^2 = 432 \text{ gal}$







Factory address: 1st Golrizan ALY, 2nd Goldis ST., Qazali Blvd,
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