Planning Recommendations

Table of contents

Page	Title
2	Comparison of different Heat Recovery Systems
5	Installation of heat exchangers
6	Product Key
7	Recommendations on leakages
8	Icing-up behavior of plate exchangers
12	Arrangement and operation of the bypass valves
14	Cleaning of polybloc-heat exchangers
15	Application of PHE in swimming pools with chlorine disinfection
16	U-Value
	Counter flow connected Plate Heat Exchanger (PHE)

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

polybloc SWITZERLAND

Comparison of different Heat Recovery Systems

	Advantages	Disadvantages
Plate Exchanger	• very low leak rate or totally leak-proof • large surfaces possible • low pressure loss • low pollution • easy to clean • no moving parts • simple load control by means of bypass damper • Polybloc : high differential -pressure strength	• voluminous when air- volume demand is high
Enthalpie-Plate Exchanger	• Humidity transfer • no transfer of smells, spores, bacteria • low leakage	• high price
Tube Exchanger	• tubes exchangeable • absolute leak tightness possible • no moving parts	• considering space requirements, small degree of effectiveness • combining of the streams of air necessary • related to the space requirements high decrease in pressure • sensitive to fouling • difficult cleaning • high price
Heating Tubes	• low leakage rate • low space requirements • no moving parts	• load control laborious • combining of air streams necessary relatively low degree of effectiveness • high price

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Comparison of different Heat Recovery Systems

	Advantages	Disadvantages
Rotating heat exchangers	• re humidifying possible • low decreases in pressure • easy line regulation	• load control laborious • combining of air streams neces-sary • large leakage rates (with increase in life.) • unfavorable shape for Mono bloc intermediate fitting. • re humidifying only at outside tem-perature less than approx. +5° C to be truly effective. • unwanted odors removed by exhaust air • wear on moving parts and seals
Switch over storage	• very high degree of effectiveness • Follow-up warming also at low out-side temperatures not need • no icing-up danger • Back damp possible • low space requirements • simple performance control by timer-switch unit • long-term stable leakage rate • good cleaning capability	• combining of air streams neces-sary • unwanted odors removed by exhaust air • wear on moving parts • high price

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Comparison of different Heat Recovery Systems

	Advantages	Disadvantages
Circulation compound systems	• only possibility of the WRG	• high decrease in pressure on the side of the air
	• at separated spatially air- stream ing	• small degree of effectiveness
	• low space requirements	• complete system labor intensive (high costs)
	• no leakage rates	• high maintenance effort
		• complicated regulation
		• antifreeze necessary
		• circulatiing pump

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Installation of heat exchangers

When installing POLYBLOC heat exchangers, attention must be paid to the following points :

- never fit ventilator pressure couplings directly on the heat exchanger surface without diffuser. If need be, mount a blank between exchanger housing and ventilator unit.

- be aware that in bypass mode, a one-way bypass can cause unfavorable flow conditions in series-components (heating registers, filters) . Installing blank components is an option, but using a centric bypass is, however, re-commended.

- icing-up of the exchanger block can occur with prolonged exposure to low outside temperatures (less than -10° degrees Celsius) , low exhaust moisture (less than 40% r. F.) and uninterrupted 24 h operation. Icing up of exchangers however seldom occurs in practice. Defrosting can be achieved by repositioning the bypass in the exhaust air and switching over to bypass mode for a short-time. Implementing a heater can become costly.

  the Enthalpie-PHE Vapobloc does not freeze in normal winter conditions as most humidity is transferred to the supply air.
  The annual payback of Vapobloc is therefore significantly higher compared to other recuperative systems like twin coils or plate heat exchangers due to more operating hours. Even if, under extreme circumstances, Vapobloc should still freeze, it will not be damaged. The risk of the Vapobloc freezing increases when operating at very cold outside air together with high humidity in the exhaust air and continuously use for more than one day.

- Experience has shown that icing up problems do not occur, independent of exhaust air moisture with intermittent operation (breaks of 6 min per 24 h)

- horizontal positioning of the exchanger plates plates is permitted for condensation, however, can increase pressure loss at low air speed and thus favor freezing. Plastic heat exchangers can be commissioned in horizontal configuration only by prior arrangement with POLYBLOC.
  Plastic plate heat exchangers must not be installed with horizontal plates! Same applies for aluminium counter-flow plate heat exchangers with the size 81, 95, 148 and bigger.

- At low average velocity (<6 m/sec) there is a good chance of decrease in pressure

- Condensate drain: The housed versions W, WBY, N, and NBY do not have any condensate filler necks, these are to be attached outside the heat exchanger accordingly. All diagonal types are fitted with two unlocked condensate-filler necks.

- When siphoning, the difference in pressure conditions between the corresponding stream of air and the atmosphere outside the housing must be taken into account.

- Concerning condensation, the smallest of leaks (also in the housing) can lead to considerable problems. Refer to recommendations on page 12 for prevention.

- For applications with a high temperature range special attention should be paid to material extension. In particular in case of different material thickness. See chapter 7.4

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

polybloc SWITZERLAND

Product key crossflow plate heat exchanger

The product codes for POLYBLOC-plate heat exchangers are structured as follows:

Example: **W 60 60 . 12 0800 AN**

Type of casing

e.g. W, WBY, N, NBY usw.

Plate spacing
(different spacing is possible)

Exhaust air
Supply air

Type	Spacing
05	2,0 mm
15	3,0 mm
20	3,5 mm
30	4,5 mm
40	5,5 mm
60	7,5 mm
80	9,5 mm
12	13,5 mm

Square size of the heat exchanger block [dm]

- ALU, ALU-Epoxy coated and stainless steel: Available in 100mm steps.
  Stainless steel and plastic: available dimensions see chapter 7.
- Up to size .14 heat exchangers are produced in one piece.

Active heat exchanger width (without frame) [mm]

- Freely selectable
- From a certain size, the heat exchanger needs to be divided in width.

Material options

AN	Aluminum
VB	Vapobloc
E2(4)	Stainless steel
PP	Plastic

The type GD (gastight welded) is defined by an own product key (see chapter 7.4.3)

Leakage Rates

Definition

The percentage leakage rates indicated by us refer to the volume flow (6 m/s) calculated from the flow velocity of the gaseous medium in the exchanger channels. The leakage rate is defined at a pressure differential between the two media (outwards) of 300Pa. At a higher pressure differential the leakage rate increases.

Type	Remark	Leakage
Vapobloc VB and CV		< 0.5%
Aluminum Crossflow Heat Exchanger		< 2.0%
Special operations	Additional seals	< 0.5%
E (stainless steel)	Seal PU max. 90°C and seal silicon max. 400°C	< 2.0%
Special operations	Additional seals	< 0.5%
E (stainless steel)	Seal max. 600°C (additional sealing not possible)	approx.. 5%
GD (gastight)	This relates to a completely welded application	0%
Accubloc		approx. 3%
PP or **PVC** (plastic)	official test of leakage occurs	approx. 0.25%

For applications which require a higher tightness an additional sealing can be executed which reduces the leakage of the plate heat exchanger even more.
The leakage of the plate heat exchanger depends on type and sealant. For example an additional sealing is not possible for the ceramic sealant, because of its high viscosity.

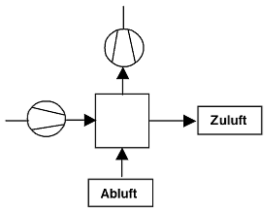
Notes:
There are several ways of avoiding unwanted effects of leakages, not only at the heat ex-changer but also generally in insulations, housing connections etc., by choosing the correct ventilator configuration with respect to the heat exchanger.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

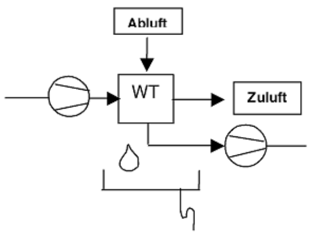
T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Leakage

Example 1
Contamination of supply air by odor- laden ex-haust air should be avoided. Regulate the pressure difference in the exchanger by the position-ing of the supply or return air ventilator so that under no circumstances (even with dama-ged exchanger), odors can be transferred. In the case of contaminated (poisonous) exhaust gas, electrical switches must be implemented to seal off the unit.



Example 2
Seeping of condensate from the exhaust air into the supply air should be avoided.



Moisture laden exhaust air should preferably be sucked away downwards. Horizontal channeling of moisture laden return air can create water pockets leading to corrosion and sealing problems.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland
T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Icing-up behavior of plate exchangers (does not apply to Enthalpy PHE)

Freezing behavior of enthalpy plate heat exchangers see page 11

An icing-up threshold in the true meaning of the word, does not exist.

Measurements taken at the Swiss College of technology Horw, Kanton Luzern, Schweiz have shown that pressure loss steadily increases at initial icing-up, which generally starts in the socalled "cold corner". At the same time, the performance remains practically constant over a long period. An explanation for this can be put down to the following: actually, the exchanger surfaces are blocked off and at the same time the air speed steadily increases due to the narrowing of the duct. The resulting increase in air turbulence causes an increase in heat transfer due to the increased Alpha values. These two contra-effects practically balance each other out.

In practice it has shown that in installations/plants without humidifiers and with very low outside temperatures, icing-up happens very slowly. With outside temperatures nearing freezing point, the rate of icing-up is at the highest. On the other hand, with high exhaust air humidification the danger of icing-up decreases. The replenishment of the condensate with sufficient enthalpy is so high that the danger of icing-up on exiting the exchanger is rather slight. Clearly the duration of the effect of lower temperatures is likewise a parameter.

A definition of the icing-up threshold is not possible. To date there is, to our knowledge, no mathematical function (backed up by measurements) to calculate the icing-up threshold. All specifications of various manufacturers regarding the subject are therefore subjective and physically not proven. Icing-up threshold originates from the times of the glass plate exchanger – where it was critical due to the danger of breakage.

Influencing factors on icing-up behavior.

The following factors play a big role in the degree of icing-up:

- The arrangement of the exchanger plates
- The routing of the air streams e.g. from top to bottom.
- On one hand, the period of below-zero temperature of outside air and on the other hand, the exhaust air temperature and humidity.

In principle, horizontal configuration of the plates is less favorable because in humid conditions, a higher pressure loss can be expected than in vertically configured plates.
Additionally, if the exchanger is operated at low air velocity the danger exists that the condensation can collect on the plates, favoring icing-up conditions.
In a vertical configuration, one should aim to position the cold corner at the bottom. This will automatically be the case if the air stream is directed from top to bottom. With diagonal configuration of the exchanger core it is favorable to channel the exhaust air obliquely downward from the top and the outside air upward from the bottom. In this way the cold corner lies at the lowest position of the exchanger core. In another case (outside air) also angled from top to bottom) condensation from the cold corner moves over the outlet edge and can lead to rapid icing up of the exchanger.

In practice, icing up of standard ventilators and air conditioners only becomes a problem with 24-hour operation. There are various solutions to the problem:

- Installation of a pre-warmer in front of the exchanger, controlled independently of the exhaust / outside temperature at the cold corner of the exchanger. This solution is uneconomical however!

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Icing- up behavior of plate exchangers

- **Provision of a defroster switch:**
  Measure the pressure drop of exhaust air, and if it exceeds 50% - direct the cold outside air through a fully opened bypass for approximately 10 - 15 minutes. In this way the outside air stream is prevented from flowing over the plate exchanger. The simplest way of achieving this is by means of an opposingly mounted bypass damper. This solution makes the exchanger somewhat larger, generally by one section of ducting. This method is more economical because of the short period of warming in each case.

- **Defroster system polybloc:**
  Once the exhaust air pressure drop exceeds 50%, the defrosting system comes into operation.
  By activating individual valve slats only a limited part of the plate heat exchanger is deiced. In this manner, a large section of the plate heat exchanger can operate at full WRG power. This type of control is specially economic as the heat recovery performance only drops by a few percentage points during the de-icing procedure. **Pre Heater must not be oversized**. Further information can be found in chapter 11 on defroster system.

- Should there be a 6-hour minimum operation break per day without any air flow through the exchanger, during cold weather, no antifreeze precautions are required. Partial icing-up of the exchanger will not cause any damage.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Icing-up Behavior of Enthalpy Plate Heat Exchangers Vapobloc

Vapobloc does not freeze in normal winter conditions as most humidity is transferred to the supply air.
The annual payback of Vapobloc is therefore significantly higher compared to other recuperative systems like twin coils or plate heat exchangers due to more operating hours. Even if, under extreme circumstances, Vapobloc should still freeze, it will not be damaged. The risk of the Vapobloc freezing increases when operating at very cold outside air together with high humidity in the exhaust air and continuously use for more than one day.

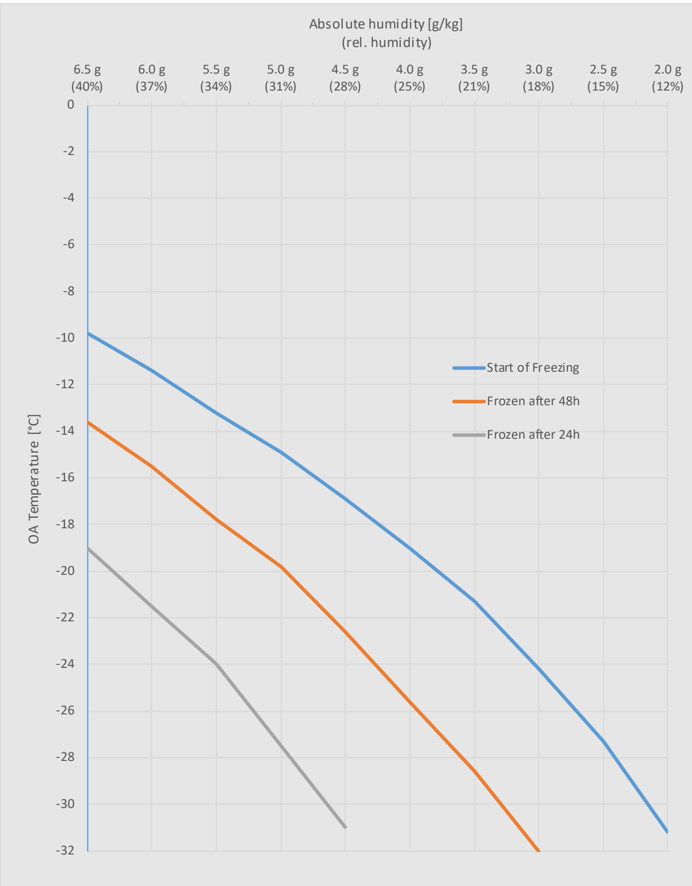
Definition of Frozen Plate Heat Exchanger

Freezing of a heat exchanger is not only a matter of temperature, but also of time. If action against freezing is taken to early, it means a big waist of energy. Normally the outside air temperature rises again during some hours or the exhaust air humidity gets lower, which creates less condensate. If 1/3 of the heat exchanger is clogged, the heat exchanger is considered as frozen.

Assuming half the condensate is drained and the rest freezes, the below graph shows when frosting starts and at what outside air temperature the heatexchanger freezes after 24 or 48 hours depending on the exhaust air temperature.

All Polybloc Heatexchangers are resistant to Ice and Water.

Example of freezing behaviour of VAPOBLOC CV
at 22°C extract air and different humidity levels



Start of Freezing:
At this temperature the maximum relative humidity of the leaving air (100%) is reached.
Below this temperature there will be some condensate

Frozen after 48 h:
At this temperature and given humidity the unit will be frozen after 48 h*

Frozen after 24 h:
At this temperature and given humidity the unit will be frozen after 24 h *

*) Frozen meens that half of the condensate freezes and is clogged by ice one third of the unit.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Configuration and drive of the bypass damper

Arrangement in the supply air current:

Advantages:

- Ice buildup can effectively be reduced by short bypass operation. Advantageous dimension: The pressure differential of the exchanger in exhaust and return airstreams. Prerequisite: sufficient dimensioning of the supplementary heater. Suitable for switchover summer/winter.

Disadvantages:

- Undesirable regulating characteristics of the bypass damper. The exhaust air is always fully available as an energy supplier. With reduced volume of supply air, heat is increased due to the retention period in the exchanger.

Order in the return air current:

Advantages:

- Good performance regulation of heat recovery.
- Low fouling of the exchanger in bypass operation in summer.

Disadvantages:

- No simple frost protection circuit possible.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

polybloc
SWITZERLAND

Configuration and drive of the bypass damper

The damper drive

All exchanger types with bypass and damper combination generally have at least one square-type drive journal on the operating and opposing sides. For transporting, the actuator shaft is secured inside the bypass duct with sticking tape when mounting the servomotor, the following must be taken note of:

- The most suitable motors are those which can be directly coupled to the shortened drive/ ac-tuator shaft and can perform a 900 rotation.

- If a hoist-type motor is used, a separate control lever must be connected to the damper shaft and the servomotor should be mounted in such a way that the louver dampers can rotate fully. Another drive shaft bearing (optionally available) must be mounted on the outside of the housing.

- The control lever should be positioned as close as possible to the exchanger wall. Connecting rods have to be kept as short as possible. The servomotors shall be mounted as securely as possible; additionally this means that the chosen location for the fastening/mounting must show corresponding stability. If necessary reinforcement may be required..

- The torque M required for the damper drive results from the following calculation. The indicated name H (dm) corresponds approximately to the square plate measurements of the heat ex-changer, the name B (m) corresponds approxi-mately to the housing breadth.

This results from the two numbers after the point in the model number. Example: Type 6060.12135 the sub-paragraph 12 corresponds to the dimension H of approx. 12 dm and B corresponds to 1.35 m plus, bypass dimension (0.25 m).

From this the following calculation arises: Factor x H + B x H = M [Nm]

0,46 x {[12 + (1,35+0.25)] x 12 }= 14.35 Nm

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Instructions for cleaning

Cleaning of aluminium and stainless steel plate exchangers

The polybloc plate heat exchangers have a highly polished dirt-repelling surface. They may be cleaned without any trouble by using a steam cleaner. Most dirt consists of fatty dust easily removed with hot water or steam.

For efficient cleaning we recommend the use of a "hot-water high pressurecleaner" (=steam jet unit) e.g. Kaercher products.

The best results with a minimum of time are ob-tained when the following values are kept:

Nozzle with angle of jet	25°	40°
Distance of nozzle to surface of exchanger	ca. 30 cm	20 cm
Pressure:	45...50 bar	
Output performance:	460 l/h	

Caution:
The distances indicated above must be kept under all circumstances, to prevent damage to the exchanger surfaces. In harsh cases of contamination, chemicalbased additives may be used for cleaning e.g. Kärcher Nr. 55 cleaning agent This product has been extensively tested by us. When used according to instructions the surfaces of the heat exchanger are not attacked.

Instruction for use
Dilute 1 litre concentrate in 10 litres water. Use jet with position "2". Clean for 5 to 30 min according to size of exchanger and degree of contamination with abovementioned product.
In case of a heavy of fouling apply for 5...10 min, and then allow to stand for 10 min and finish off as described above.

Caution:
The quoted cleaner does not harm varnished parts. Working temperature range 10 - 150°C. Has a surfactant base and does not contain any hydrocarbons. Must, however not be subjected to freezing temperatures
Do not use any socalled aluminium cleaners! These are very caustic and attack the surface, resulting in the exchanger becoming recontaminated much quicker.

Instructions for cleaning for PP- and Enthalpy-Pleat Heat Exchangers see next sheet.

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

Instructions for cleaning

Cleaning of synthetic material plate exchangers

Synthetic material plate heat exchangers must be cleaned with special caution. Never use a high pressure cleaner. The maximum temperature of:

- 60 °C for PVC
- 90°C for PP(s)

may not be exceeded even for a short time!

We recommend connecting a piece of rubber hose fitted with a spraying nozzle to a water supply and clean the heat exchanger with tepid water.

Pressure: approx 4 bar
Distance between nozzle and exchanger sur-face must not be not less than: min. 50 cm

Cleaning of entahlpy pleat heat exchangers „Vapobloc“

The Vapobloc should be checked regularly for dirt and be cleaned if necessary. At least once a year the Vapobloc must be cleaned in order to maintain its latent effectiveness.

Moderate contamination can be dealt with by rinsing the exchanger with warm tap water (max. 60°C). If necessary a mild dishwashing liquid such as Palmolive or Pril could be added.

Do not use a high pressure cleaner - it could damage the membranes.

Application of POLYBLOC air/air-plate exchangers for heat recovery in ventilati-on systems of swimming pools with chlorine disinfection

Definition

Hazardous materials found in the return air include Chloroform which is limited to a maximum concentration of 200 µg / m3 due to health safety requirements, and Hydrochloric Acid in minimal concentrations formed by the combination of water and Chlorine.

Both of the abovementioned combinations are highly corrosive to metals when concentrated.

When using a plate heat exchanger in the ventilation system of a swimming pool, the possibility of corrosion must be taken into account. Corrosion on the return-air side is not significant in dry conditions. Only when air condition is below dew point condensation will form on the returnair side. Then the concentration of the chlorine will decrease due to the large amount of condensate.

How is corrosion prevented in POLYBLOC PHE ?

POLYBLOC plate exchangers are constructed from 99% pure aluminum as a base material, and is comparable to stainless steel 4301 as far as resistance to various mediums is concerned.

The resistance against weak acids is slightly better than against weak alkalis.

To greatly improve on the corrosion resistance in swimming pool applications, the surface is coated on both sides with a thin epoxy film. The core housing is epoxy powder-coated pure aluminum.

Field Experience

The previously mentioned application has con-vincingly proven itself over the last 20 years in swimming pools using Chlorine disinfection. Neither has POLYBLOC had to replace an exchanger due to corrosion, nor have our clients (manufacturers of swimming pool ventilation systems) found any corrosion within the lifespan norms for such systems.

POLYBLOC's plastic heat exchangers, likewise on offer for the past 20 years, have hardly ever been used in swimming pool ventilation systems. The application of these exchangers is limited to highly corrosive environments such as return air from galvanizing plants or thermal/ therapeutic baths.

References for both types of exchanger are readily available.

polybloc SWITZERLAND

U-Value

Plastic heat exchangers are often said to deliver insufficient performance as plastics do not conduct heat as efficiently as aluminum for example. The example below shows that the difference in performance between the various materials is insignificantly small.

$$U = \frac{1}{+\frac{1}{\alpha_1} + \frac{s}{\lambda} + \frac{1}{\alpha_2}} \quad [W/m^2K]$$

α_1 = heat transfer on one side of the HE wall [W/m²K]

α_2 = heat transfer on the other side of the HE wall [W/m²K]

s = Material thickness in **m**

Alu = 0,1 mm = 0,0001 m
PP = 0,7 mm = 0,0007 m

λ = heat conductivity of the wall material

Alu = 200 [W/m2K]
PP = 0,23 [W/m2K]

$$U_{Alu} = \frac{1}{\frac{1}{50} + 0{,}000\,000\,5 + \frac{1}{50}} = 24{,}99 \quad [W/m^2K]$$

$$U_{PP} = \frac{1}{\frac{1}{50} + 0{,}003043 + \frac{1}{50}} = 23{,}23 \quad [W/m^2K]$$

d. h. 7 % lower than with Alu

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com

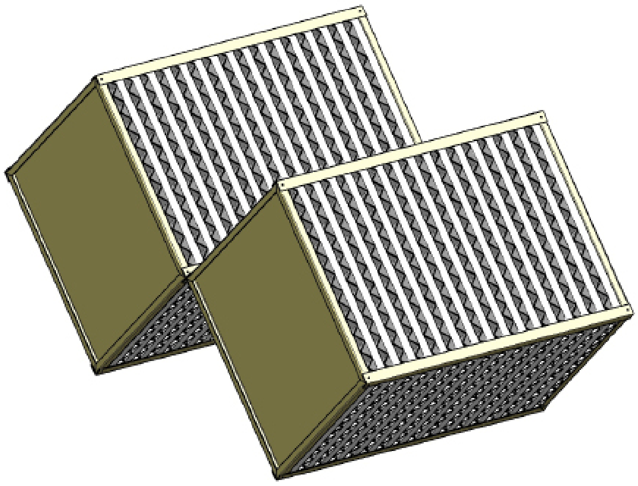
Counter flow connected Plate Heat Exchangers (PHE)

Multiple PHEs of the same type and performance can be connected together in series to form a complete unit. In this case it is required and that the air streams must be blended before entering the following section.

1. Total dry effectivity

The efficiency index can be approximately calculated by the following formula:

$$\Phi_g = \frac{\Phi_1 + \Phi_2 + (1 + \frac{\dot{m}_{FOL}}{\dot{m}_{AUL}}) \times \Phi_1 \times \Phi_2}{1 - (\frac{\dot{m}_{FOL}}{\dot{m}_{AUL}}) \times \Phi_1 \times \Phi_2}$$



Φ_g = total dry effectivity

$\Phi_{1...2}$ = dry effectivity of single unit

POLYBLOC AG
Fröschenweidstrasse 12
8404 Winterthur
Switzerland

T +41 52 235 0190
F +41 52 235 0191
info@polybloc.com
www.polybloc.com