

## Twin-channel kiln for large size tiles: high output and flexibility in small spaces

### 为大规格瓷砖而生的双通道窑炉：小空间里的高产量与灵活性

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The growing production of large size tiles in the ceramic sector has given rise to a new problem: the elimination of residual post-firing stresses to allow for subsequent operations of cutting, drilling, etc. For this purpose, large size tiles need to be fired for much longer times than medium-sized tiles, regardless of the stresses generated in the previous steps.

Given that the use of large kilns affects the quality of finished products and limits the range of thicknesses and surface finishes, the solution is to use very long kilns, although this is sometimes not compatible with the spaces available.

To solve this problem, Welko has developed a twin-channel kiln with two independent channels positioned one above the other. This solution offers numerous advantages:

- The kiln length is halved,
- Occupied space is halved,
- The two channels can be operated as two independent kilns,
- Two different kinds of products can be produced at the same time,
- Two different cycles can be used in the two channels,
- The same product can be produced at the same time in the two channels,
- Consumptions are reduced thanks to the lower heat losses.

Let's look at the kiln's main technical characteristics.

**The two channels are separate and independent.** The two channels' service fans and combustion plants are completely independent, while the thermal insulation allows very different operating temperatures to be maintained in the two channels without affecting each other.

**Separate and independent pressure management.** The pressure in each channel is regulated and controlled in-

陶瓷行业大规格瓷砖生产的不断增多引发了一个新问题：如何消除烧制后的剩余内应力，以便进行后续的切割、钻孔等操作。为此，不管前面步骤中产生的内应力或大或小，大规格瓷砖比中等规格瓷砖烧制更长时间。

鉴于大型窑炉的使用会影响产品的质量并限制了产品的厚度和表面效果，由此而产生的解决方案是使用非常长的窑炉，但这可能会出现空间不够的情况。为了解决这个问题，Welko开发了一种具有两个独立通道立式双层窑炉。

该解决方案具有许多优点：

- 窑炉长度减半，
- 占用空间减半，
- 两个通道可以作为两个独立的窑炉进行运作，
- 可以同时生产两种不同的产品，
- 两个通道可以使用两个不同的周期，
- 可以在两个通道中同时生产同一种产品，
- 由于热损失减少，因而降低了能耗。

下面是该窑炉的主要技术特性。

**两个通道是分开、独立的。**两个通道的服务风扇和燃烧设备完全独立，隔热层能够使两个通道保持完全不同的操作温度，且不会相互影响。

**分离、独立的压力管理。**在烧制区和冷却区，每个通道中的压力独立调节和控制，从而保证即便生产出现缺口，产品仍然保持一致性。

**最大的灵活性。**在不失去对整个过程的控制的情况下，窑炉可进行单个通道运作。在这种情况下，热消耗会高出7-10%。

dependently in both the firing and the cooling zone, thereby guaranteeing product consistency even after gaps in production.

**Maximum flexibility.** The kiln is designed to function with a single channel without losing control of the process. In this case specific heat consumption is 7-10% higher. Energy recovery. The kiln uses hot air recovered from cooling as combustion air for the burners (expected savings of 7% compared to a kiln with cold air).

**Hot air recovery for use in the dryer.** The hot air recovery system is also able to recycle hot cooling air for use in dryers, if present on the line. The reduction in heat consumption in the drying stage can be as high as 40-50%.

**High-efficiency burners.** The same burners are used as those developed for the single-channel kiln. These intensive combustion burners generate the flame entirely inside the combustion cone, thereby optimising the efficiency and exit speed of the fumes and generating convective currents inside the channel to facilitate temperature uniformity and energy transfer to the material undergoing firing.

**Inverters.** The fans are equipped with inverters, allowing the kiln's sensitive variables to be controlled without using valves but simply so as to optimise electrical energy consumption.

**Consumption.** Depending on the type, thickness and dimensions of the tiles and the firing cycle, heat consumption varies from 500 to 600 kcal/kg, while electrical energy consumption amounts on average to 0.04 kWh/kg.

### 】 Production process advantages

The first Welko twin-channel kiln has been in operation since September 2016 in the Laminam facility in Borgotaro for the production of large size tiles with thicknesses ranging from 6 to 20 mm; a second kiln was started up in Spain in January 2018 for the production of tiles with thicknesses of 3 and 6 mm.

Experience in the field has demonstrated:

- the possibility of producing the same product with the same colour in the two channels;
- complete product changeover management with automatic changing of the temperature and pressure curve,
- complete management of production gaps.

In all conditions, consistent flatness and colour and zero kiln breakages are achieved at the kiln exit. X

**能量回收。**窑炉使用冷却区内回收的热空气作为燃烧器的助燃空气（与含冷空气的窑炉相比，预期节省7%的能量）。

**热空气回收用于干燥机。**热空气回收系统还能够将生产线上存在的热冷却空气进行循环用于干燥机上。干燥阶段热耗最高可降低40-50%。

**高效燃烧器。**使用与单通道窑炉相同的燃烧器。这些强化燃烧器完全在燃烧区内部产生火焰，从而优化效率和废气的排出速度，同时在通道内产生对流传热，促使温度均匀并把能量传递给正在燃烧的材料。

**逆变器。**风机配备了逆变器，可以在不使用阀门的情况下控制窑炉的敏感性，达到优化电能消耗的目的。

**能耗。**根据瓷砖的不同类型、厚度、大小和烧成周期，热量消耗的变量从500至600千卡/千克不等，电能消耗平均为0.04千瓦时/千克。

### 】 生产工艺优势

自2016年9月起，第一台Welko双通道窑炉在Borgotaro的Laminam工厂投入使用，生产厚度从6到20毫米不等的大规格瓷砖；第二台窑炉于2018年1月在西班牙启用，生产厚度为3和6毫米的瓷砖。在该领域的经验表明：

- 可以在两个通道中生产相同颜色的相同产品；
- 温度和压力曲线的自动改变实现了完整的产品转换管理，
- 生产缺口的完善管理。

在任何情况下，出窑后的瓷砖始终保持平整度和颜色一致以及在窑炉中的零破损。 X

