

Nutec Bickley's IMPS® – an Energy Efficient System for Firing Ceramics

Introduction

In today's world, being energy efficient while firing ceramics becomes a strategic issue for companies competing in a market where trading conditions are very aggressive. The cost of operating the kilns where ceramic products are fired is a critical element for the competitiveness of companies in the ceramic industry and a key decision factor for selecting the best option when acquiring a new kiln. *Nutec Bickley/MX* offers cutting edge kiln technology for firing ceramics and is able to meet the current challenges where the market is demanding.

Quality vs. energy efficiency

Most ceramic firing processes require the kilns to have a very tight temperature uniformity to ensure product consistency and quality. Kiln design, together with process practices, are key ingredients for temperature uniformity.

Kiln design has evolved over the years and two main techniques are used to promote temperature uniformity:

- Firing with high volumes of excess air
- Using a pulse firing combustion and control system.

Firing with high volumes of excess air

Using excess air while firing ceramics means using more air than what is actually required for proper combustion. Excess air increases uniformity by increasing the amount of heated mass (the extra air) in a kiln and thus increasing convection. With this in mind, the more excess air in a firing process, the higher the energy cost to operate the kiln. This technique was used some years ago when fuel costs were not a consideration and when the hardware and software used in kilns did not offer kiln builders or the ceramic manufacturers any other option.

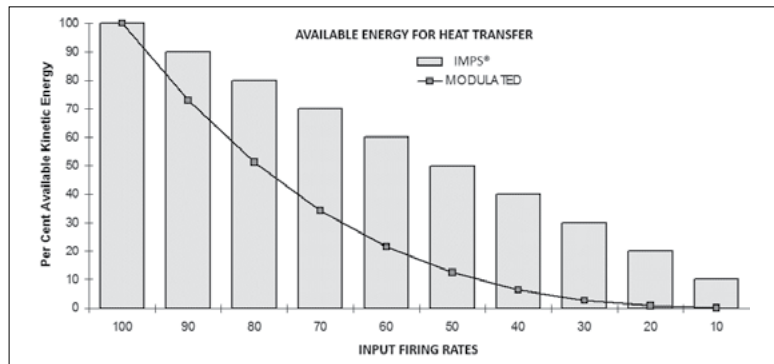


Fig. 1
Available energy for
heat transfer

Using a pulse firing combustion and control system

One of the best available options for efficiently firing ceramics without the need of big amounts of excess air is a pulse firing system. A pulse firing system uses a time/proportion algorithm to turn burners from high-fire to low-fire as the means for temperature control. Pulse fire increases uniformity by increasing convection (and therefore heat transfer) by only firing the burners with maximum velocity and efficiency. Compared to other techniques, pulse fire offers the following advantages:

- Decreases operating costs by decreasing fuel costs.
- Reduces emissions by allowing burners to perform at the optimum operating position.

IMPS® – Nutec Bickley's pulse firing system

The concept for pulse firing is not new, the technology has been available for many years, however to this date, traditional firing system such as cross connected ratio system, fuel only control or oscillating systems are still the most common combustion-control systems

Nutec Bickley and *GFC Kilns* (an Australian company bought by Nutec Bickley in 2008) are pioneers on pulse firing technology and have been manufacturing kilns using pulse firing systems for more than 20 years. IMPS® which stands for

Integrated Multi-zone Pulsing System is Nutec Bickley's own version of the pulse firing system. IMPS® takes advantage of years and years of experience in firing ceramics using pulse firing techniques. It also incorporates very sophisticated control algorithms, controls, multiple firing modes and special hardware which are all designed to have a very efficient firing process.

Nutec Bickley's IMPS® includes several modes of operation to cope with the different needs required by the process such as steaming, partial excess air firing, on-ratio firing, reduction firing, slow cooling and rapid cooling which makes possible for the user to vary the conditions inside the kiln depending on what product and what each firing segment requires.

IMPS® links together all the control zones within the kiln and considers how each control zone influences each other and with this information the kiln automatically regulates itself to give very accurate temperature control. By using the different modes of operation, very tight temperature uniformities can be achieved throughout all of the firing segments of a firing cycle, this reduces the need for excess air just to

Rodrigo González

Nutec Bickley
Santa Catarina, Mexico
E-mail: sales@nutecbickley.com
www.nutecbickley.com



Fig. 2 IMPS® shuttle kiln for sanitaryware



Fig. 3 IMPS® shuttle kiln for vitrified clay pipes



Fig. 4 IMPS® tunnel kiln for technical ceramics using pre-heated combustion air

create the required temperature distribution conditions.

The requirements for high levels of excess air are reduced by using the kinetic energy produced by pulsing the burners from high-fire to low-fire to increase the available energy for heat transfer. Fig. 1 shows how the available energy for heat transfer varies comparing IMPS® and a traditional cross connected modulating system at different input firing rates. In addition to this, IMPS® uses the burners only in two operating outputs; high-fire and low-fire.

This system allows the burners to always perform at their optimum operating position; when the burner is in high fire we have higher flame velocities, more recirculation and entrainment and a larger radiation area, all of this increase the heat transfer rate and promotes better temperature uniformity.

The IMPS® system can be used on multiple ceramic firing processes such as (Fig. 2–4):

- sanitaryware
- abrasives
- electroporcelain insulators
- refractories
- technical ceramics
- fiber processing
- clay pipes.

Over the years it has been demonstrated that using IMPS® can reduce the fuel consumption by an order of 25–30 % compared to kilns using other traditional systems.

Using IMPS® with energy recovery technologies

Nutec Bickley's IMPS® is a very flexible system and it can also be used in conjunction with other energy recovery technologies. Many times, Nutec Bickley kilns have been equipped with systems combining both pre-heated combustion air and

IMPS®, the result is one of the most efficient systems available to fire ceramics.

While promoting excellent temperature distribution and reducing the need to have high levels of excess air in the segments where the product doesn't require it; with IMPS®, by using pre-heated combustion air, it is possible to recover the energy from waste gases which are being exhausted from the kiln. Energy is available throughout the heating portion of the firing cycle on a batch kiln and continuously on the cooling exhaust on tunnel kilns. An IMPS® system can use air pre-heated combustion air up to 500 °C.

IMPS® is not only a possibility for new kiln installations. Using IMPS® on an existing kiln installation is an available option for most companies firing ceramics. Over the years, Nutec Bickley has retrofitted many kilns with state of the art combustion and control systems, making it possible for companies to have the efficiencies and quality required by the market today with a small capital investment.

With the increased level of quality and the reduction on energy consumption the typical rates of return of investment on these type of projects is between 1 and 2 years.