

Pakistan Case Study

Energy Efficient Brick Production: Vertical Shaft Brick Kilns

Background and Context

Brick production is a large and rapidly growing industry in many parts of Asia, especially Pakistan. This is courtesy the consistent growth in the construction industry that boasted of an average growth rate of 1.2% during 2000-04 and then experienced a great boom during 2004-07 when it grew at an average rate of 18% per annum¹. The expansion in brick production is a direct result of the progress in the socioeconomic indicators of the country, leading to a great increase in public and private construction projects. Dozens of mega housing schemes were launched, there was a surge in development activities in urban areas such as Lahore, Rawalpindi/Islamabad, Faisalabad, Hyderabad, Multan, Gujranwala, Sialkot and Sargodha, and dozens of high rise commercial buildings cropped up all over the place. The volume of civil works in the public sector, spearheaded by the local governments was also significant during this period².

Unfortunately, since the brick manufacturing industry is infamous for consuming large amounts of coal and producing high CO₂ emissions, this progress came at an extremely high cost for the environment. As in other developing countries, brick kilns in Pakistan are also owned by small scale entrepreneurs, often employing a poorly qualified, low paid work force and releasing high carbon emissions due to the inefficiencies and ill adapted technologies in place. The most favored method for brick baking is still the fixed chimney bull's trench kiln (FCBTK) which has been causing a horde of environmental issues, and demands that there be a strict compliance of standards, or a shift to green brick manufacturing and alternative production methods.

This case study will attempt to elaborate on the Vertical Shaft Brick Kiln (VSBK) method of baking bricks, and shed light on the work done by the Swiss Development Cooperation in introducing it in Islamabad/Rawalpindi. It presents an exhaustive overview of the technology, the Energy Efficient Brick Prod project, the obstacles it encountered, and via consultation with the team also attempts to put forward recommendations for the increased use of VSBK's replacing the traditional highly carbon emitting kilns in use.

VSBK: The Technology

A Vertical Shaft Brick Kiln is an energy efficient technology used for fired clay brick production. The technology was originally developed in China. It consists of rectangular, vertical shafts. Dried green bricks and coal are stacked into batches, which are continuously loaded into the top of the shaft. As the batches

¹Nielson. Study on Construction Trends in Pakistan. SKAT SDC. Jan 2010.

http://www.eebp.pk/PDf/Study%20on%20Construction%20Trends%20in%20Pakistan_1.pdf

² Ibid

gradually pass through the shaft, the green bricks encounter pre-heating, firing, and cooling zones before they reach the shaft exit at the bottom³.

Carbon dioxide emissions of a VSBK are 30% to 50 % lower than other kilns, and suspended particulate matter, the principal cause of air pollution, is reduced by up to 80 %. The construction of a VSBK requires very little land. Due to the fact that a VSBK can only be fired with coal (or with coal dust), deforestation of rural areas and use of waste such as tyres can be eliminated⁴. It also economizes on fuel costs, with savings of 30% to 50 % as compared to other common brick firing technologies⁵.

Unlike other brick firing technologies where a uniform quality of fired bricks is not possible due to heat losses, the fired bricks in VSBK are 95% uniform in quality, and are of one class⁶.

Furthermore, the operation of the Vertical Shaft Brick Kilns offers a

significant improvement in working conditions of the kiln workers. The Energy Efficient Brick Production Project by the Swiss Development Cooperation writes, with regards to the VSBK's:

It protects fire masters from exposure to toxic gases while operating the kilns. The kiln's short firing cycle allows rapid correction of operational errors but also requires more careful and disciplined handling. The Pakistani context allows further improvement of the working condition through the introduction of mechanic equipment, which will further ease the operation and reduce the fire masters' exposure to heat and dust. Furthermore, the introduction of semi-mechanization in the green brick production will considerably improve the working conditions and

³ Energy Efficient Brick Production. SKAT SDC. <http://www.eebp.pk/Projects.htm>

⁴ Ibid

⁵ Ibid

⁶ Ibid

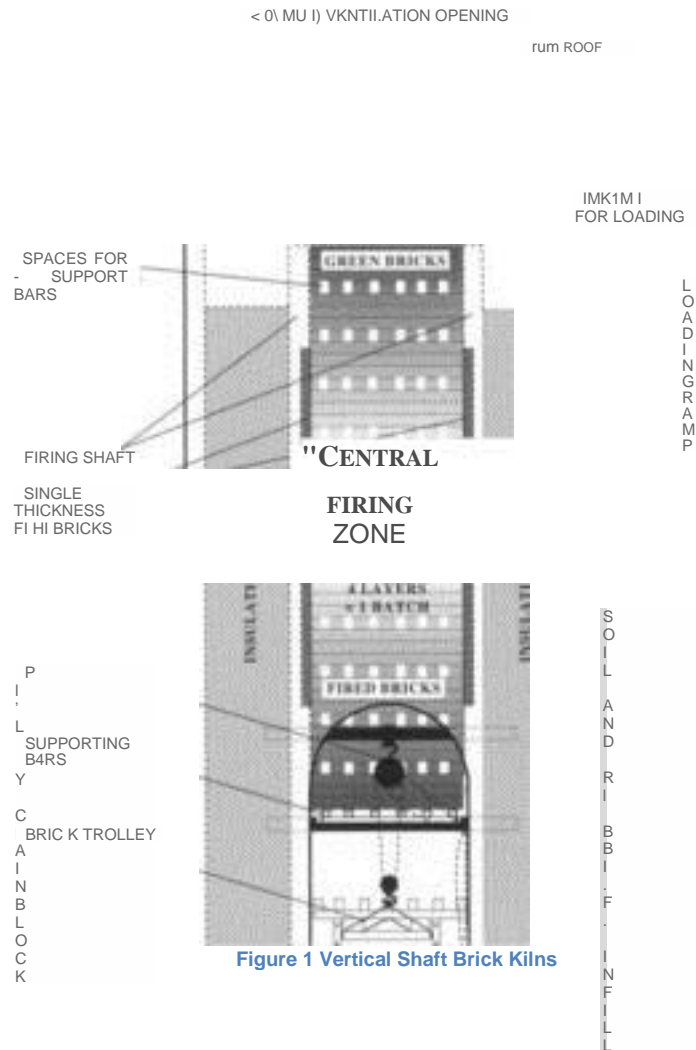


Figure 1 Vertical Shaft Brick Kilns

has the potential to advance the labour situation dramatically, particularly on the level of child labour and women and bonded labour.^{3 4}

Due to its short firing cycle and handy firing control, VSBK is the ideal medium scale firing technology for a machine that makes bricks. Hollow bricks are not only less sensitive towards firing errors; they also reduce coal consumption by another 20-50%. In addition, perforated bricks reduce transportation energy and have good thermal insulation properties.

It's not only low carbon, but brick production using VSBK technology is also a highly profitable business. The initial investment is low, as compared to other cleaner brick making technologies (e.g. Hoffmann or Tunnel kilns) but higher than for traditional kilns. The VSBK can be operated all year round, and the scale of output can be easily adjusted to the market demand. The maintenance costs are minimal, and no external power source is required except for electric lighting during the night operation. This results in a 30-50% coal savings, thus reducing the brick production costs. In the Pakistani context, the VSBK profit calculations, based on the first production experiences shows a fuel reduction of 35-40%, resulting in a realistic profit increase of nearly 30%, as soon as the tuning of operation and coal supply is completed, and the kiln is well managed. For a newcomer to the brick business, the payback period of a fully new VSBK brickyard is 18 months, instead of 15 months for a traditional brick yard.

PERFORMANCE CRITERIA

TYPE OF KILN	ENVIRONMENTAL PERFORMANCE	SOCIAL PERFORMANCE	BRICK QUALITY
VSBK Moveable and fixed chimney BTK	High Low	High Low^t	Medium Medium
Tunnel kiln Clamp and intermittent kiln's	High Low	Medium Medium	High Low

Figure 2 Comparison with other technologies⁸

With regards to environmental performance, VSBK scores high, due to the fact that it has lesser CO2 emissions and is the most energy efficient. In social performance indicators, a properly designed VSBK will score high. SKAT's model business plan stated:

*"through incorporation of chimneys, mechanization of green brick lifting and brick loading process, it is possible to minimize occupational health risk and drudgery for workers. VSBK has been found to be a suitable technology for small- and medium-scale production"*⁵

³ Energy Efficient Brick Production. SKAT SDC. <http://www.eebp.pk/Projects.htm>

⁴ SKAT EEBP. *Model Business Plan for VSBK in Pakistan*. March 2010. <http://www.eebp.pk/Pdf/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan%204.pdf>

SKAT EEBP. *Model Business Plan for VSBK in Pakistan*. March 2010.

Finally, VSBK produces medium quality bricks with lower breakage rates when the green bricks are of good *quality (adequate strength, regular shape and size and so on)* for example the SKAT plan states:

"when they are produced using machines such as extruders and soft mud molding machines. In China and Vietnam, where all the bricks are extruded, VSBK fired brick quality is better compared to the quality of bricks fired in traditional kilns. In India and Nepal, VSBK has given good results with hand-molded bricks also."

The Project:

In 1996, the Swiss Agency for Development and Cooperation (SDC) supported the know-how and transfer of the VSBK technology from China to India through an action research programme, in close collaboration with Development Alternatives (DA). The Chinese technology was adapted to the Indian context and improved with reference to the environment, energy performance and working conditions. To date, the SDC has made 120 VSBKs operational in India, in the same way as it had introduced the kilns in Nepal, in early 2001. Subsequently, the Swiss Resource Center and Consultancies for Development (Skat) has further improved the VSBK technology and optimized green brick production methods in both the Asian countries⁶. Through the SDC this efficient low carbon technology was transferred to Pakistan, with the goal to assess the technical and economic potential of the brick making and also demonstrating the viability of the VSBK technology in selected areas of Pakistan.

After the initial research phase of the project, the project titled the 'Energy Efficient Brick Production' established two demonstration kilns as pilots for alternate production. The aim was to influence government policies and provide new technical solutions to the private sector. Furthermore, the project also aimed to integrate social elements within the larger narrative of low carbon construction. The main objectives of the project were:

1. *To introduce environment friendly brick production technology in Pakistan.*
2. *To promote energy efficient brick production technology.*
3. *To support entrepreneurs in design, construction and operations of VSBK units.*⁷

After running the kilns on full capacity for a year, SKAT and SDC found:

1. *High quality VSBKs can be established with local material supply, within the expected price level.*
2. *Laboratory tests have proven that VSBK bricks can compete with the upper brick quality segment of the Pakistani brick market.*
3. *The Project has demonstrated that a correctly operated VSBK reduces energy consumption (and CO2 emissions) by 30-50%.*

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[http://www.eebp.pk/PDF/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan 4.pdf](http://www.eebp.pk/PDF/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan%204.pdf)

[http://www.eebp.pk/Project Brief.htm](http://www.eebp.pk/Project%20Brief.htm)

⁷ SKAT EEBP. *Model Business Plan for VSBK in Pakistan*. March 2010.

[http://www.eebp.pk/PDF/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan 4.pdf](http://www.eebp.pk/PDF/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan%204.pdf)

4. *First production cost assessments have confirmed, that a full scale VSBK will generate considerably higher profits than a traditional brick kiln and that its comparative advantage will further increase with the rising coal price.*
5. *VSBK considerably improve working conditions, in particular exposure to toxic gasses and heat and will offer alternatives to bonded- and child labor exploitation.*
6. *The first production experiences have shown that the kiln can be operated on a high profit level. However, the production and supply tuning must be conducted carefully and cannot*
7. *be ignored to achieve the desired results⁸.*

Obstacles and Recommendations

Though road transport, railways, chemical factories, cement factories, crushers, open drains and solid waste are considered to pose a rather serious threat to the environment and human health, brick kilns and their carbon emissions are never discussed with the same sense of urgency. Builders, architects and engineers might think that environmental friendliness is an important aspect, but it will still not impact the decision making process. The EEBP acknowledged this gap and recognized that there is a dire need to launch a campaign generating awareness among regulatory agencies, builders/architects, end users and the general public. Furthermore, these campaigns need the endorsement and support of the Pakistan Environment Protection Agency.⁹ The involvement of the authorities is the most important thing for eradicating institutional barriers.

Secondly, the cost effectiveness of VSBK should be highlighted as the marketing strategy. Pakistani brick manufacturing industry might not be immediately responsive to the low carbon element, but the economics of the situation will be a good lure. However, even though the technology is economical and cost effective in the long term, it requires a significantly large investment at the start. Partnerships with government agencies or banks should be developed to ensure easy and economical access towards financing options for entrepreneurs. In this connection, Small & Medium Enterprise Development Authority (SMEDA) can be of much help.¹⁰

Lack of ownership and acceptability for the VSBK technology by the local investors and entrepreneurs was also stated to be one of the main reasons behind the failure of previous attempts at introducing the technology in parts of KPK¹¹. SKAT strategically established the VSBK plants in collaboration with the

⁸ SKAT EEBP. *Model Business Plan for VSBK in Pakistan*. March 2010.
http://www.eebp.pk/PDf/Model%20Business%20Plan%20for%20VSBK%20in%20Pakistan_4.pdf

⁹ Nielson. *Study on Construction Trends in Pakistan*. SKAT SDC. Jan 2010.
http://www.eebp.pk/PDf/Study%20on%20Construction%20Trends%20in%20Pakistan_1.pdf

⁴ Nielson. *Study on Construction Trends in Pakistan*. SKAT SDC. Jan 2010.
http://www.eebp.pk/PDf/Study%20on%20Construction%20Trends%20in%20Pakistan_1.pdf

Engr Abrar Ahmad. *Contemporary Brick Manufacturing Technologies: A comparative analysis with special reference to the Pakistani perspective*. 2009.
<http://www.eebp.pk/PDf/EEBP-Alternative%20Technologies%20Study%20Report%20Feb%202009.pdf>

local investors, garnering a wide acceptability. Furthermore, there is also a need for wider dissemination and awareness via print and electronic media before establishment of the kilns, in order to prepare the ground for the intervention.

More pilot VSBKs be established in areas like Lahore, Sialkot, Sargodha and Faisalabad. The clusters of kilns in these areas will be able to observe the VSBK technology once it is in operation near them. In this connection, PR should be developed with the opinion leaders of this industry (i.e. union office bearers)¹².

Conclusion

The kiln industry in Pakistan, as in other Asian / South Asian countries is conservative in nature. Most of the investors and technical persons are not trained at any institution and are more concerned about a "quick-returns on investment", thereby depending upon traditionally available technical know-how and manpower. There is a negative perception towards new and innovative technology with specific reference to the lack of training, low capacity to adapt and absence of sustainability. While introducing the VSBK concept, these factors play an extremely important role in the level of acceptability and ownership of the technology.

Via consultations and archived documentation from the EEBP project, it has become glaringly obvious that it's the lack of awareness and involvement on the part of important institutions and government authorities that is becoming an impediment towards the widespread implementation of green brick baking and manufacturing. The government needs to firstly, recognize brick making as an industry, requiring regulations, policies and standards like any other manufacturing industry. Furthermore, they also need to prioritize the education and awareness building of local manufacturers and kilns workers with regard to low carbon options and use their influence to support/facilitate a smooth transition towards these methods.

Nielson. Study on Construction Trends in Pakistan. SKAT SDC. Jan 2010.
http://www.eebp.pk/Pdf/Study%20on%20Construction%20Trends%20in%20Pakistan_1.pdf