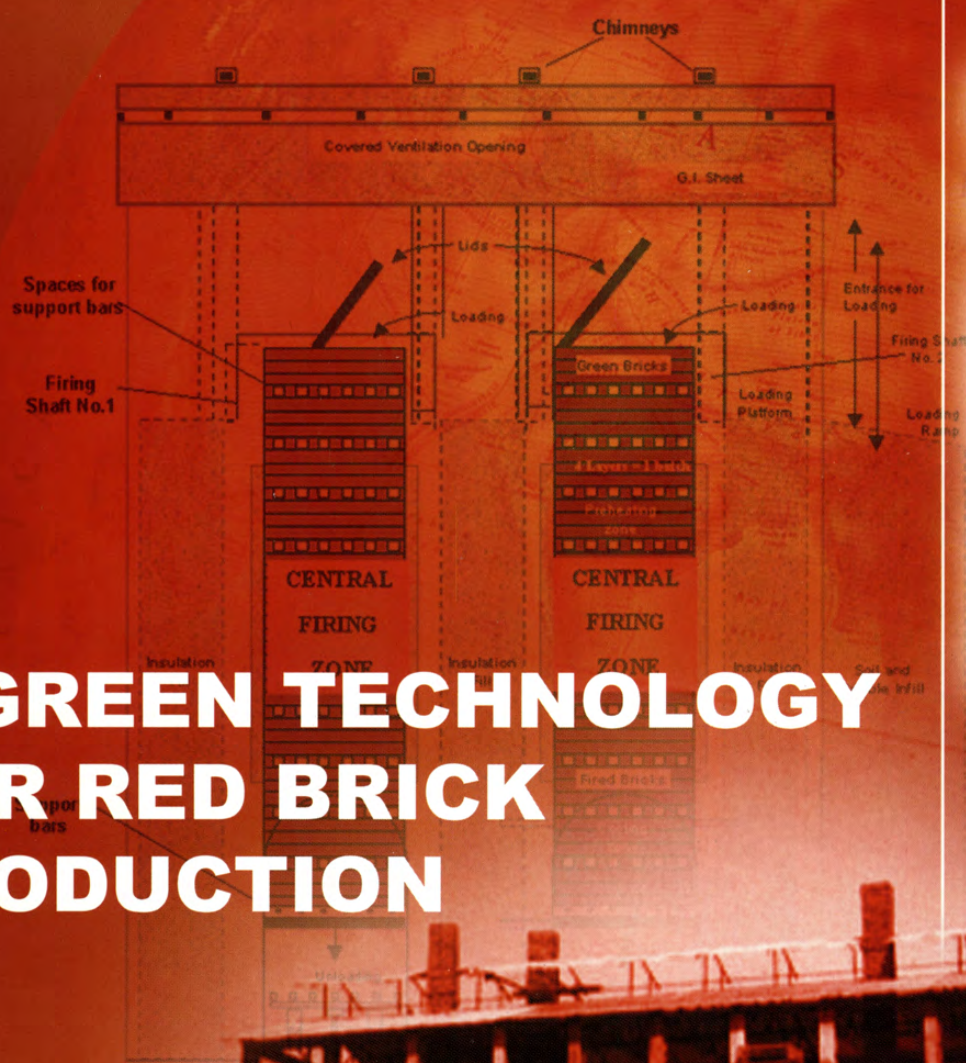
Vertical Shaft Brick Kiln

TECHNOLOGY

VSBK



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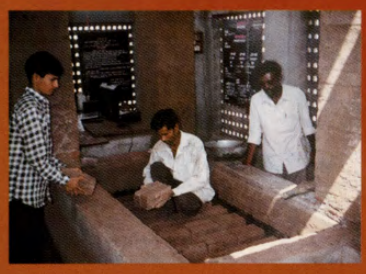

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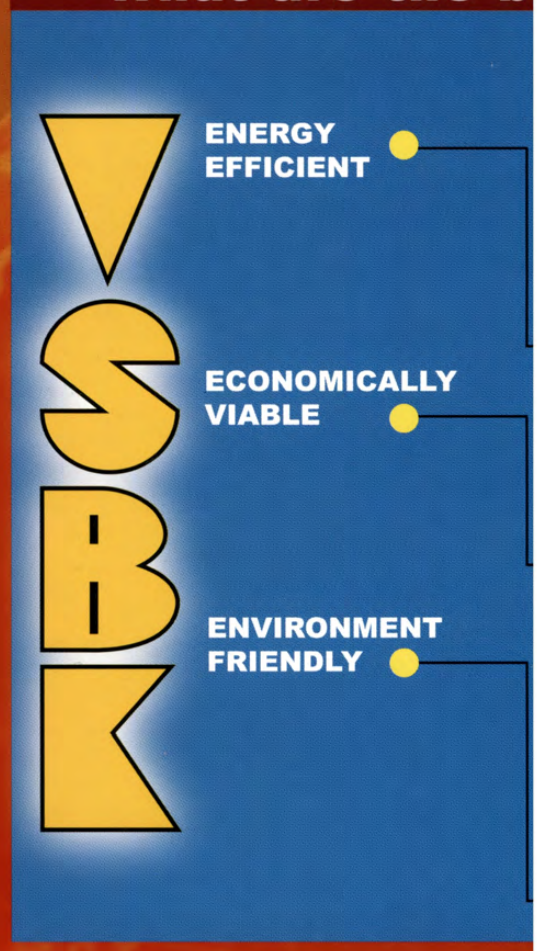
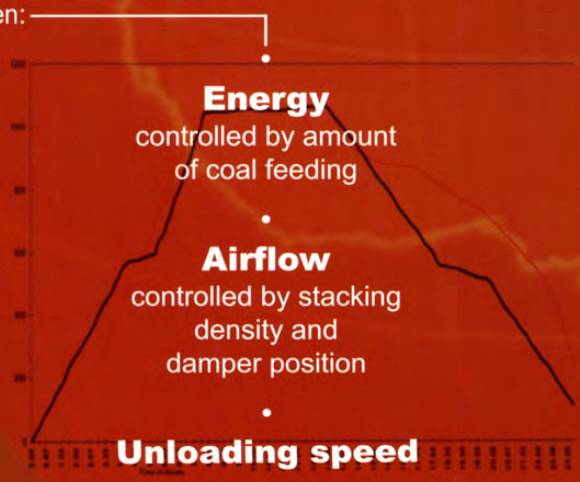


What is a Vertical Shaft Brick Kiln (VSBK)?

A Vertical Shaft Brick Kiln (VSBK) is an energy efficient technology for fired clay brick production; the technology was originally developed in China. It essentially consists of one or more rectangular, vertical shafts within a kiln structure. Rectangular arrays of dried green bricks and crushed fuel (coal) are carefully stacked into batches, which are continuously loaded into the top of the shaft. At the bottom of the shaft, batches of fired clay bricks are continuously removed. As the procession of batches gradually passes through the shaft, the green bricks encounter pre-heating, firing and cooling zones before they reach the shaft exit.

The VSBK relies on the principle of a counter current heat exchanger in order to achieve high thermal efficiency. When the shaft lid is in the closed position, the entire kiln is actually a chimney. The efficiency of the VSBK is immediately reduced as soon as the lid is opened.

The heating cycle for the green bricks is raw material specific (pre-heating,vitrification and cooling down) and is normally completed within 24-30 hours. This requires special skills and the firing operator needs to maintain a correct balance between:



What a policy maker needs to know

Vertical Shaft Brick Kiln

TECHNOLOGY

What a policy maker needs to know

Frequently asked Questions

1. What are the proven environmental and socio-economic benefits of the VSBK technology?

The VSBK technology is an energy efficient and environment friendly brick firing technology that can save between 30 to 50 percent of fuel; depending on operating conditions. Due to the high energy efficiency, pollutant emissions are within norms prescribed for kilns. The VSBK technology has justifiably acquired the image of a clean brick firing process.

The VSBK technology has flexibility of scale (from micro to small scale) with a high potential for promoting entrepreneurial ventures and job creation opportunities. Moreover, the VSBK technology is a socially acceptable technology, because no child labour is possible for its routine operation.

With the VSBK, working conditions are vastly improved in comparison to conventional brick firing techniques and workers who load the brick shaft are less exposed to suspended dust and smoke. The VSBK limits the spread of heat, rubbish (ash) and coal dust. The VSBK roof gives protection to the workers from the sun, which is a major factor in sub-tropical climates. Due to possibilities for year-round operation; socio-economic concerns such as the seasonal migration of workers, employment insecurity and exploitation by contractors can be gradually influenced in a positive manner.

A VSBK can only be fired with coal or coal dust, and does not use wood or cow-dung. Uncontrolled deforestation of rural areas can, therefore, be reduced by promoting VSBK technology.

2. Is the VSBK a proven and developed technology?

The present VSBK technology is "State of the Art" and is both field proven **and** commercially viable as a brick firing technology. However, since each country,

place and even local setting differs; the VSBK technology must be adapted to local conditions on a case by case basis. However, considerable fine-tuning is required during the technology introduction phase to ensure successful operation of the pilot plants and to meet the expectations of the entrepreneurs in terms of quality and profitability.

3. Is poverty alleviation possible with this technology?

Yes. The VSBK technology provides a great potential for poverty alleviation. However, capacity building at all levels is a prerequisite, from design stage right through to construction and subsequent operation. The locally created capacity will translate into more jobs with higher skill levels and better paid livelihoods.

The potential shift in local industry from seasonal to an all year around brick production will gradually change working patterns, favouring social development and improving the security of livelihoods.

Further, the VSBK technology can easily be scaled to accommodate the practical requirements of each market segment. At the lowest level, even self-help groups, community groups and micro enterprises could operate the VSBK technology.

4. Is the VSBK technology a potential factor for changing the existing brick industry?

The VSBK technology has been verified to adhere to strict environmental norms specifically laid out for the brick industry in India. The VSBK technology intrinsically limits the generation and diffusion of waste heat, combustion products and dust. These factors are extremely significant during brick production.

The VSBK is an excellent technology for ensuring compliance with environmental regulation. The VSBK introduces new elements such as the partial mechanisation of brick handling during loading and unloading operations. This change confers added status to the industry and results in more compact production areas that are less offensive to the eye. The VSBK technology can be used as an effective change agent for setting standards in the brick and rural industries in developing countries.

5. How is the private sector involved in the VSBK technology transfer?

The optimum capacity and size of a Vertical Shaft Brick Kiln is between 2 and 4 shafts, which is the equivalent of a production level of about 8'000 to 16'000 bricks per day.

The VSBK system can achieve good productivity with minimum management, making it attractive for small and family enterprises. The involvement of the private sector is essential for dissemination of the benefits of VSBK on a wide scale. The role of the private sector must be integrated into any mechanism envisaged for large-scale technology transfer. All costs related to the construction and operation of the VSBK must be borne by private entrepreneurs without subsidy.

The local anchoring of know-how related to VSBK technology is crucial. A commercial network of institutions and support service providers (private sector) will be required to bear the responsibilities for:

- Design and construction
- Supply of equipment and accessories
- Sustained capacity building

6. What kind of external institutional support is required for the introduction of VSBK technology in a new region?

Experience from the VSBK projects in India clearly shows that VSBK technology transfer can be effectively achieved within 4 to 5 years, including local capacity building. A technology transfer project must be designed for initial success.

Key elements of recent successes in VSBK technology transfer have been identified as:

- The establishment of (or use of an established) central coordination agency that acts as a local node for affecting major improvements, continually regulating the pace and process of know-how transfer.
- Initial establishment of a temporary network of institutions and support service providers.
- Institutional linkages based on South - South cooperation
- Sustained capacity-building in VSBK technology
- Sustained energy and environmental monitoring to enhance performance.

  Careful project management at all stages. Milestones and decision criteria need to be clearly defined and progress monitored closely.

7. What steps are required to introduce the VSBK technology?

Firstly, a techno–economic feasibility study should be conducted to confirm the commercial potential of the VSBK technology at the outset. This is already the first "Go - No-Go" milestone.

After a positive analysis, the tasks of project planning and management should be assigned to an experienced VSBK technology transfer agency with a proven track record in the field. This agency should also be a technology provider during the pilot phase. It is important that the technology provider has the capacity to assist local counterparts in tailoring a suitable VSBK technology transfer strategy to suit specific circumstances and requirements.

The following are the important learnings from the Indian experience:

- Working through a lead agency that is internationally connected to a network of reputed and experienced VSBK experts is crucial for success.
- Long term involvement of the technology provider is vital.
- Introduction of the VSBK technology with diverse partners and variable situations is extremely desirable.
- No compromise should be entertained in the support of capacity building initiatives.

8. Who can provide the required support services?

At present there are only a very limited number of VSBK technology providers worldwide. In India, the organisation with the most practical VSBK technology transfer working experience is **Development Alternatives (DA),** based in New Delhi. At an international level, the Swiss Center for Development Cooperation in Technology and Management (**SKAT**), in Switzerland is the leading organisation with the most up-to date practical experience of VSBK technology transfer.

For energy and environmental monitoring purposes, TERI, in New Delhi, India, is the most experienced organization.

For more and detailed information about VSBK technology and support service providers, see attached information.

9. Where is the VSBK technology a success?

The Vertical Shaft Brick Kiln technology evolved in rural China in the early 1970's. During the decade, the kiln became popular in several provinces. In 1984, the Chinese Government commissioned a study to improve the kiln's energy efficiency. The Government then partly supported the dissemination of the technology and by 2000, between 50,000 - 60,000 VSBK were estimated to be operating inside China.

The VSBK technology has recently been successfully transferred from China to India. The Government of India is in the process of validating the VSBK as a green technology. All commercially constructed and operated VSBK enterprises in India are reported to be profitable. The SDC (Swiss Agency for Development and Cooperation) has financed the VSBK technology dissemination project which has stimulated a huge demand for this technology. The mechanisms to privatise and liberate the VSBK technology are now being organised to meet the requirements of the commercial brick entrepreneurs.

10. Is specific VSBK technology literature publicly accessible?

Yes. In fact, there are entire VSBK-related libraries maintained at Development Alternatives and TERI in New Delhi and at SKAT's offices in Switzerland. In addition, specific VSBK technology manuals have been produced during the VSBK technology transfer process in India.

- VSBK Design Manual
- VSBK Construction Manual
- VSBK Operation Manual
- VSBK Firing Document

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History of the VSBK technology

Vertical Shaft Brick Kiln

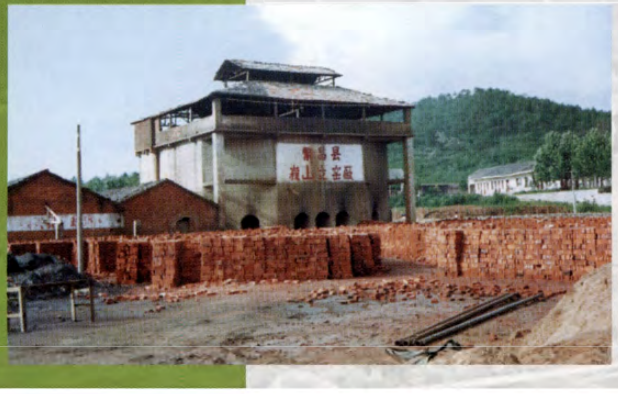
TECHNOLOGY

History of the VSBK technology

Where did it all start?

The Vertical Shaft Brick Kiln technology evolved in rural China. The first version of Chinese Vertical Shaft Brick Kilns originated from the traditional updraft intermittent kiln in the early 1970's. During the decade, and in tune with the economic reform processes initiated in 1979, the kiln became popular in several provinces. In 1985, the Chinese Government commissioned the Energy Research Institute of the Henan Academy of Sciences at Zhengzhou, to study the kiln and improve its energy efficiency. The Government partly supported the dissemination of the technology. By 2000, between 50,000 to 60,000 VSBK units were estimated to be operating in China. Here, the VSBK technology is used for small-scale brick production only. Production rates using the VSBK technology generally vary from 2,500 bricks to 20,000 bricks per day.

VSBK technology is well suited to decentralised production methods, a factor that has contributed towards its successful adoption in China. Simple mechanisation is used for material handling, transport and extrusion of green bricks. Internal fuel in the form of coal, biomass and sawdust is added during the moulding of green bricks – this creates highly favorable conditions for short cycle firing. It should be emphasised that the time interval between loading of green bricks and unloading of fired bricks is 24-30 hours as compared to 20-30 days in most conventional kilns. The VSBK technology represents a flexible means of brick production since output is proportionate to the number of shafts placed in service. A typical kiln can be constructed and commissioned within 6 weeks.



The VSBK technology outside of China

Several attempts have been made to transfer the VSBK technology from China to other countries.

Encouraging beginnings in Nepal

In 1991 under a GTZ-GATE project, a twin shaft VSBK was constructed at Kathmandu Brick Factory, Lubhu, Nepal. One more VSBK was built in Biratnagar, Nepal.

With an energy consumption of around 1 MJ per kg of fired brick, the energy saving potential of the VSBK technology was clearly demonstrated.

However, both kilns ran into early technical problems that the entrepreneurs could not solve unaided. In spite of strong indications that the technology had great potential, initial enthusiasm was eventually replaced by disappointment and the two Nepalese VSBKs closed down. The lack of access to reliable technical support was responsible for early failure.

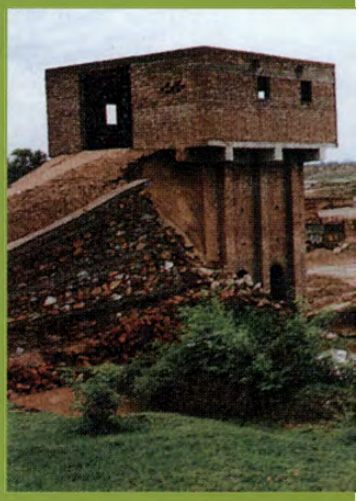
An enthusiastic welcome in Bangladesh

With the assistance of SDC, a brick kiln owner from Bangladesh visited one of the VSBK units in Nepal. Inspired by what he saw, the entrepreneur subsequently built a VSBK near Dhaka. Unfortunately, the need for specialised technical assistance was again overlooked. This Bangladeshi pilot VSBK plant was never commissioned.

The attempt to transfer know-how to Bangladesh was a spontaneous, private initiative.The entrepreneur did not know the finer aspects of the technology and without the requisite technical back up, he made fundamental mistakes in the design and construction of his kiln.

Production capacity becomes an issue in Pakistan

In 1993, a VSBK was demonstrated in Peshawar, Pakistan; again under a GTZ-GATE development project. This was followed by the construction of several VSBK units in the same region.



In Pakistan, the VSBK demonstration units (twin shaft design) were marketed as an alternative to the Bull's Trench Kiln (BTK) technology. However, the typical production of a BTK varies between 15,000 and 50,000 bricks per day in Pakistan. With only two shafts, the VSBK demonstration units could not produce more than 3,000 bricks per day. There was a clear imbalance between the output capacities of these dissimilar technologies.

This difference proved to be a major stumbling block in attracting the attention of BTK owners towards VSBK. Inappropriate information on the limits and potentials of the VSBK technology resulted in a misjudgment which limited its marketability. As a consequence of this oversight, the VSBK technology made no significant break-through in Pakistan beyond the early pilot project successes.

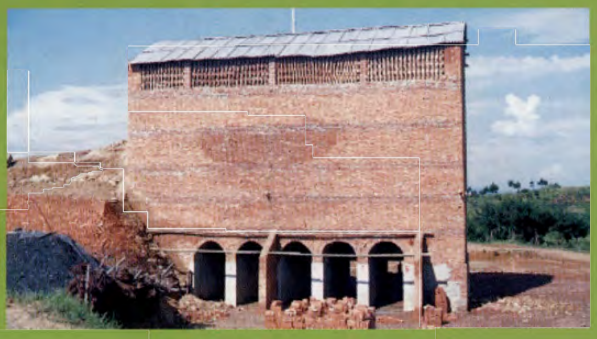
Alternative fuels tested in Sudan

A VSBK was adapted for use in Sudan during 1996. A pilot kiln was constructed by the Building and Road Research Institute (BRRI) of the University of Khartoum in cooperation with GTZ-GATE.

The fuel used was carbonized agricultural waste from cotton stalks, sunflower stalks or bagasse. The carbonized fuel, reduced to a granular size was dispersed among the green bricks when loading the kiln from the top. This VBSK was the first of its kind which uses carbonized agricultural waste. No recent updates on the operations of the technology are available.

Large scale production in Afghanistan

In 1995, the Pakistan VSBK-GTZ project provided training for engineers and kiln-crews from Heart,Afghanistan in order to construct one 6-shaft VSBK for the Afghanistan Rehabilitation and Energy Conservation Association.



Three additional 6-shaft VSBK units were constructed by private entrepreneurs and a total of 4 such units (i.e. 24 shafts, each of 1m x 1m) were reported to be in operation in 1996. The status of these kilns today is not known.

Success is seen in India

In 1996, SDC (Swiss Agency for Development and Cooperation) supported the organised transfer of VSBK technology to India through an elaborate Action Research Programme. The process was initiated through a team of local and international experts. This team was commissioned to analyse the mistakes committed in earlier attempts to transfer the VSBK technology beyond its native environment and to identify the success factors responsible for its growth in China. Based on the outcome of the study, a project was formulated for the transfer of the VSBK technology to different geographical regions in India.

The first VSBK kiln was set up in Central India at Datia in Madhya Pradesh. This kiln, based on Chinese designs was set up in joint partnership with an experienced local brick clamp owner. Initially, a team of Chinese specialists provided on-site operational support services. Local support and key personnel were provided by Development Alternatives to assist in the construction process and operation of the kiln. This pilot confirmed the potential energy savings associated with VSBK and demonstrated the technical feasibility of short cycle brick firing using Indian soils and fuels.

Buoyed by encouraging results, a second kiln using slightly larger shafts was constructed in East India. This was quickly followed by a third kiln for firing extruded bricks, set up in association with (and at the behest of) a reputed manufacturer of fired clay products.

All of these early kilns assisted in the building up of local capacity for design, construction and operation while demonstrating improved environmental performance. The performance of the kilns was continuously upgraded with the assistance of local partners, consultants and international backstoppers. By May 2001, twelve kilns were operational in various geographical regions.

As a result of the early successes during the first phases of technology transfer; SDC, together with different local partners, is now implementing the dissemination of the VSBK technology in India.

The positive factors responsible for the successful introduction of VSBK in India have been identified as follows:

Assured Technology and Technical Support

- Provided by a local lead agency, committed to dissemination of the VSBK technology
- Local adaptation of the technology
- Long-term involvement of the Chinese VSBK experts
- Establishing conditions for improving the energy efficiency and environmental performance of the VSBK technology
- Anchoring technological know–how in local institutions
- Supported by an International pool of organizations and experts
- Involvement of project partners with diverse competence

Promotion of VSBK Technology

- Correct marketing strategy of the VSBK technology
- Early involvement of bricks entrepreneurs from amongst clamp owners and relatively small kiln operators
- Capacity building at all levels
- Introduction of technology in diverse regions and markets of India.

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http://www.vsbkindia.com

What an entrepreneur needs to know

Vertical Shaft Brick Kiln

TECHNOLOGY

What an entrepreneur needs to know

Frequently asked Questions

1. What is the rate of production of a VSBK?

It depends on the number of shafts you build. A 4-shaft kiln produces about 18,000 bricks per day. Operation is round-the-clock and annual production of upto 3 million bricks has been achieved from a commercial VSBK operating in India. The kiln can be operated throughout the year and even during monsoon time.

2. What advantages do I get if I switch over to a VSBK?

A VSBK gives you unmatched flexibility of operation, good product quality and substantial savings in energy. You can plan a precise production schedule and produce exact quantity of bricks that you require. Once operational, loading and unloading is carried out simultaneously. In general, one batch of bricks is loaded (and one unloaded) every two hours. The bricks remain inside the kiln for approximately 24 to 30 hours instead of the 20 to 30 days required with a BTK. This reduces the working capital substantially.

3. Do I get bricks of good quality?

Yes, you can get bricks of high quality using a VSBK if you follow good firing practices. In fact, the products may be superior to those of your existing kiln. VSBK-fired bricks show a fine, deep red color and have a good, metallic ring. A compressive strength of up to 180 kg/cm^2 can be achieved using good quality soils. Compared to the BTK where 2nd and 3rd grade bricks are produced in significant quantities, a VSBK produces mostly 1st grade bricks. Breakage and wastage can be limited to within 5 percent through stable operation of the VSBK.

4. What kinds of bricks can I fire in a VSBK?

Both wire-cut (extruded) bricks and hand-moulded bricks can be fired in a VSBK. The choice is entirely yours. Extruded bricks can achieve a compressive strength of up to 300 kg/cm^2 after firing. The VSBK is extremely versatile in operation. In addition, you can fire hand-moulded bricks together with extruded bricks and even 'gutta' or modular bricks (8" x 4" x 4") in the same VSBK.

However, you can only fire walling bricks in a VSBK. Other clay products such as clay roofing tiles, hurdi blocks or floor tiles cannot be fired using this technology.


Monsoon Operation

5. Is the Vertical Shaft Brick Kiln a profitable business?

Yes it is. The Vertical Shaft Brick Kiln allows you to retain complete control over product quality, unit production cost and pollution emissions. Fuel costs alone are at least 25 percent lower than those associated with the operation of conventional kilns. Throughout the year, your saleable bricks will represent more than 90 percent of your total brick production.

The VSBK kiln with two shafts can be set up in 2000 sqm. of land, and 4 shafts in 4000 sqm., excluding the brick-moulding area. With an initial investment of approximately US $ 17,000 sales of up to US $ 120,000 per annum have been achieved with handsome profit margins.

6. How do I know if the local soil is suitable for producing VSBK bricks.

The VSBK is amazingly versatile for firing bricks made with different qualities of soil. In almost all countries, there are organisations which have fully equipped and certified testing laboratories. You should get your soil, coal, green bricks and fired bricks tested for quality and performance only at these certified laboratories.

Generally, if good bricks can be made in a BTK the same soil can be used in a VSBK to make good bricks.

what an entrepreneur needs to know

7. What kind of fuel can I use in a VSBK

The choice of fuel is based on cost considerations and the quality of product desired. Based on the location, steam coal and even lignite pellets are being used effectively. The recommended coal size is between 3 to 15 mm.

The VSBK firing system functions at its best when only internal fuel is used.

8. Do I need trained technical personnel for operating a VSBK?

Initially, yes. You will need specially trained fire masters for proper VSBK operation. However, help is at hand. The VSBK technology provider in your area is capable of providing all the necessary specialist skills for designing the kiln and supervising its construction. The technology provider will provide on-the-job training for your firemen. This will normally take 3 to 4 weeks once the new kiln has been commissioned.

9. What is the life of a VSBK?

A VSBK can be used for many years if good firing and maintenance practices are observed. The expected service life of a VSBK is between 10 to 15 years.

10. Do my workers need to change working patterns?

Yes. Your workers will have to adjust their working habits. The VSBK firing system requires 24-hour supervision of operations. One batch of fired bricks needs to be unloaded (and one batch of green bricks loaded) at regular intervals, normally every two hours. This means that even throughout the night, the VSBK needs to be staffed for regular loading and unloading operations of the kiln.

11. Where can I get more information?

Your local technology provider will be pleased to answer all of your questions so that your business is able to take full advantage of VSBK technology.

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VSBK Action Research Project India

Vertical Shaft Brick Kiln

TECHNOLOGY

Why Change?

The conventional burnt clay brick is the most widely encountered walling material used by India's construction industry. This is in spite of a proliferation of economically viable alternative technologies, based on local and sustainable resources. These alternatives include concrete blocks, fly-ash bricks and other industrial products.

Burnt bricks are used in huge volumes; exceeding 100 billion per annum. The current technologies prevalent for firing bricks in India (such as periodic or intermittent clamps and continuous Bull's trench kilns) consume excessive quantities of energy for each brick burnt. The quality of coal used for such brick production can have an ash content as high as 40%. Excessive particulate pollution is a by-product of the combustion process.

The resultant emissions from the stacks of large brick production facilities severely affect the flora and fauna and the surrounding habitat. The detrimental effect on trees and vegetation is quite serious from the point of view of sustainable livelihoods. Damage to agriculture and horticulture crops in areas close to brick making units is extensive. Inhalation of the dust produced by the firing process represents a serious health hazard that brick workers must endure.

In economic terms, the net contribution of burnt bricks towards national energy requirements is very significant. The production of construction materials accounts for 27% of total national energy consumption. If the production of burnt bricks is allowed to grow uninhibitedly to meet the anticipated demand for housing, a doubling of the 1990 production figures will occur by 2020. The resultant CO_2 emissions would also double during the period 1990 to 2020. These figures serve to highlight the enormous magnitude and alarming growth of energy consumption (and resultant pollution) associated with 'Business-As-Usual' brick production methods. On such a scale, even a modest reduction in specific consumption of fuel (tons used per thousand bricks produced) will have a significant positive impact on the national energy scenario.

The VSBK 2000

The **"State of the Art VSBK"** was constructed in Datia after incorporating all the acquired learning that emerged during the VSBK Action Research Phase. This kiln is used for capacity building and demonstration of best practices. It is operated by Development Alternatives.

The first commercial VSBK in India (Gwalior)

The first operation on a commercial scale was launched with the fifth VSBK at Gwalior in Central India. The kiln was initially built with twin shafts; the addition of two more shafts subsequently led to a production capacity of 16,000 bricks per day from 4 shafts, each measuring 1m x 2m. The kiln is serviced with a two way ramp for movement of green bricks.

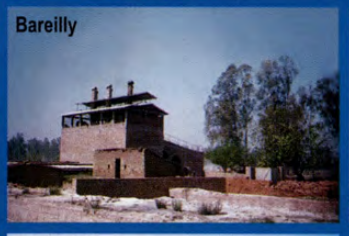
The owner of the first commercial VSBK in India is making good profit and regularly achieves up to 50 percent savings in energy compared to the traditional clamps he has operated for decades. He has achieved an annual production exceeding 3 million bricks from operations of the VSBK.

And more commercial VSBK


Tekanpur


Gwalior


Amravati


Bareilly


Varanasi


Aurangabad

These commercially operated kilns have provided very significant learning regarding variations in the requirements of entrepreneurs to suit particular market conditions. The varied experiences from pilot kilns and kilns operated by entrepreneurs have established robust foundations for the widespread transfer of VSBK technology to institutions in India. The project is now posed for large scale dissemination.

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The VSBK Technology Transfer to India

Environmental reforms in the brick and other energy intensive sectors are largely in response to the Rio Conference Agenda 21. It was against this backdrop that SDC (Swiss Agency for Development and Cooperation) proposed a systematic programme to influence and augment building material production in response to rising demand, at the same time seeking to conserve energy and benefit the environment.

The SDC initiated Action Research Project was centered on the Vertical Shaft Brick Kiln technology (VSBK. It was reported that the VSBK technology had been used very effectively to sustain the growth of brick production in China during the eighties. The VSBK is now known to be an energy efficient and environmentally sound technology, with up to 50,000 kilns operational in China.

Formation of a multi-disciplinary team to anchor technology in India:

The success of any technology transfer process depends to a large extent on the capacity of the recipient to absorb the technology. In the Indian Small & Medium Enterprise sector, it is difficult to find a single enterprise or institution having the capacity to absorb, adapt and diffuse the VSBK technology. Thus, a multi disciplinary team was formed, comprising of representatives from industry, research organizations, technology developers and disseminators.

International back-stoppers and technical experts subsequently supported this team throughout the entire action research phase.

The VSBK Action Research Project Team consisted of:

DA (Development Alternatives), a technology development group who were entrusted with the responsibility of project co-ordination, environmental monitoring and practical project implementation, coupled with construction of VSBK units, technology anchorage, documentation and capacity building.

TERI (Tata Energy Research Institute), a major Indian organization in the field of energy and environment was accorded the responsibility for monitoring energy performance and providing technical solutions for enhancing the energy efficiency of the VSBK technology.

SKAT (Swiss Center for Development Cooperation in Technology and Management), a Swiss consulting organization, was assigned the overall responsibility for project backstopping. This activity consisted of (Coaching) networking, capacity building through practical training, quality control and advisory responsibilities.

SORANE SA, a Swiss consultancy firm was assigned the role of technical advisor to SKAT in all energy-related matters pertaining to the refinement of the VSBK technology.

Research Project Team

Dynamic technology transfer approach:

A dynamic approach was adopted to transfer know-how within the recipient organizations for strengthening indigenous capacities to assimilate and adopt the new technology. Efforts were also undertaken for building long-term capacity in technology innovation. Some key steps were taken as part of the knowledge transfer and capacity building process:

Long term involvement of the technology supplier:

Three year involvement of the technology supplier (Chinese team) was planned to ensure complete knowledge and skills transfer to the Indian team.

Capacity building:

Capacity building of the local team included regular information exchange among team members through meetings, workshops and exchange of experiences. Systematic interaction with national and international experts in the areas of ceramics engineering, brick production, kiln technology and techno-commercial evaluation was organized to achieve indigenous capacities at all levels. Indigenous capacities now exist to design, construct and operate new kilns.

Promoting the VSBK as a technology for small scale production:

The Indian brick industry has a lot of diversity in terms of preferred firing techniques, types of kiln encountered and scales of production. Based on initial interaction with the domestic brick industry and on documented experiences of neighboring countries, it was decided at the project outset to promote the VSBK as a small capacity, flexible technology. The VSBK production units would not be promoted as direct competitors of large output Bull's Trench Kilns. VSBK pilot plants were, therefore, constructed in areas where the production levels of existing brick producing units matched with the production capacity of a suitable two shaft VSBK demonstration unit; namely up to 10,000 bricks per day. In such cases, bricks are generally fired in open clamps. The introduction of the VSBK technology was seen as an alternative to clamp kilns.

Pilot testing and multiple anchors for VSBK technology:

India is a large country and considerable regional variations are observed across the brick industry in terms of raw materials (quality and cost of clay and fuel), climatic conditions, technology selection and final product quality. In response to these variations, it was decided to pilot test the VSBK technology at four different locations with four different institutions in the Northern, Southern, Eastern and Western zones. Multiple anchors of the technology were put into place primarily:

- To reduce the risk of a single institution monopolising the technology.
- To reduce the risk of failure with respect to technology transfer.

This approach also ensured establishment of regional nodes for technology dissemination in the future.

Step by step exposure of the technology to market conditions

The experience of VSBK technology transfer in Pakistan indicated that undue involvement of the entrepreneur or local industry during the initial phase of pilot testing is not desirable. Significantly in India, the first two pilot plants were established with NGOs. SDC provided financial support for the construction and operation of these two plants and the project retained substantial control in the management of these pilot plants. The initial pilot testing was, therefore, conducted in a closely controlled environment. Once the technical viability and energy conservation potential of the technology had been demonstrated under Indian conditions, the next two pilot kilns were established with private entrepreneurs.

Yang Mongxiu & Yin Fuyin
the Chinese VSBK experts

Research provisions for continuous technology adaptation

Brick making is a complex process influenced by properties of local clays, fuel, climatic conditions, skills available and local market conditions (such as prevailing product quality and pricing). The continuous adaptation of the VSBK technology to local requirements is necessary. The need for adaptive research was identified early in the project. Apart from ensuring long-term access to the services of the Chinese team, provision was also made for involving national and international ceramic, energy and environment experts to help regional partners in the adaptation of the technology. The provisions for further research are ensured in order to respond to the evolving needs of entrepreneurs.

The VSBK in India

The first VSBK in India (Datia)

The very first twin shaft VSBK in India was constructed in 1996 in Datia. The design of the kiln was adapted to suit local conditions; foundations were built in stone masonry and a sloping roof was used to enclose the structure. A brick masonry ramp was constructed for the transportation of green bricks.

Several improvements were effected over time to improve the environmental and energy performance, leading to the adoption of an open and ventilated structure. Provision of a roof monitor and multiple chimneys with dampers ensured a cleaner and safer work place. These actions established the technical feasibility of operating the VSBK under local conditions. Subsequent energy balance and environmental impact audits quantified the levels of energy efficiency and environmental performance that could be expected with VSBK operation.

The second VSBK in India (Kankia)

The second pilot VSBK was constructed at Kankia in East India, taking into account the improvements already made at Datia. The second VSBK had two enlarged shafts, each with a rectangular cross-section of 1m x 1.75m. The kiln was built on two levels, with loading of bricks at road level and unloading at a lower level. The performance with respect to energy and environmental factors was again very good, with over 30 percent savings in energy compared to common practice in the region.

The third VSBK in India (Kerala)

The third pilot kiln was built in association with *Comtrust*, a leading fired clay product manufacturer in South India. The product quality from this kiln was significantly better than the output of the earlier kilns. Innovations such as mechanized hoisting of bricks were introduced for commercial brick production. A positive outcome of this phase of the project was that *Comtrust* demanded the addition of two extra shafts to increase the capacity of the VSBK to 12'000 bricks per day for profitable operations. This kiln provided very valuable experience, with good quality soils and humid climate conditions; prevalent in South India.

The fourth VSBK in India (Pune)

The fourth pilot VSBK was built in Pune (Maharashtra) where the soil quality is very poor but the market demand for bricks is very high. This kiln was built especially for gathering important commercial and business information on VSBK operations. The shaft sizes where 1m x 2m and 1.25 x 2m. These were the largest shafts constructed during the VSBK Action Research Project in India.

A GREEN TECHNOLOGY FOR RED BRICK PRODUCTION

efits of a VSBK?

The VSBK technology economises on fuel costs, with savings of between 30 to 50 percent when compared with other common brick firing technologies such as clamps or Bull's trench kilns with movable chimneys.

Brick production using VSBK technology is a profitable business and the initial investment is low. The VSBK can be operated all the year round. Weather factors have only a minor influence because a roof protects the kiln.

The construction of a VSBK requires very little land. The building of multiple shaft production units further enhances the ratio of land use to production output. As a VSBK can only be fired with coal (or with coal dust), deforestation of rural areas can be controlled. Additionally, if a VSBK is operated properly, emissions are much lower compare to common rural brick firing technologies.

The VSBK in facts and figures

Shaft Size (metres)	1.00 x 1.00	1.00 x 1.50	1.00 x 1.75	1.00 x 2.00	1.25 x 2.00
Daily throughput per shaft (bricks) @ 11 batch shaft height	2,000	3,000	3,500	4,000	5,000
Specific Energy Consumption	• 0.72 to 0.95 MJ/kg. of fired bricks				
Emissions from stack (mg/Nm^3)	• 22 to 37 (SPM) • 38 to 51 (SO_2)				
Compressive strength of bricks (kg/cm^2)	• 70 to 115 (hand moulded bricks) • 125 to 300 (extruded bricks)				
Construction cost (USD)	• Between 6,000 and 8,000 for a twin-shaft kiln				
Construction time (weeks)	• Approximately 6				

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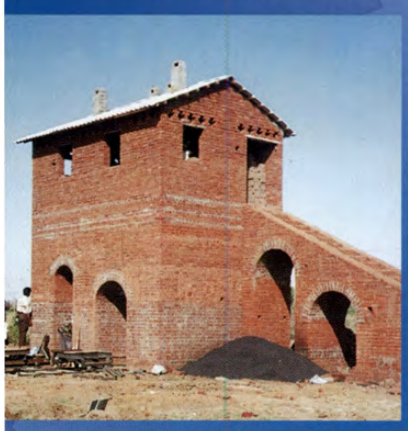
This Brochure has been presented to you by:

A host of information brochures, product catalogues, video films and kiln-specific information is also available though **Development Alternatives,** and **TERI** in India and **SKAT** in Switzerland. For those with access to the Internet, more information is available on the website

http://www.vsbkindia.com

The VSBK technology: **a successful introduction in India**



The introduction of VSBK technology in India took place in 1996 through the construction of a pilot kiln in Datia. The pilot kiln was based on a Chinese design, consisting of a brick masonry structure with two shafts having rectangular cross-sections of 1m x 1m and 1m x 1.5m. The final construction was adapted to reflect local conditions; stone masonry was used to construct the foundations and a sloping roof was used to protect the structure. A masonry ramp was constructed for transporting bricks from ground level to the loading platform. Hand moulded bricks were used for firing. The kiln has been constructed on the site of an experienced clamp owner.

The original Chinese kiln design underwent several modifications, which greatly enhanced the environmental and energy performance. These changes resulted in a considerably open and ventilated structure. The provision of a roof monitor and multiple chimneys with dampers served to promote a cleaner and safer work place. These actions established the technical feasibility of operating the VSBK under local conditions. The brick quality is consistent and marginally superior to the locally produced clamp fired bricks.

The second pilot VSBK was constructed at Kankia in East India taking into account the improvements already made at Datia. This kiln had two shafts each size of 1m x 1.75m. The kiln was built on a split level with loading of bricks at the road level and unloading at a lower level. The performance with respect to energy and environmental factors was repeated.

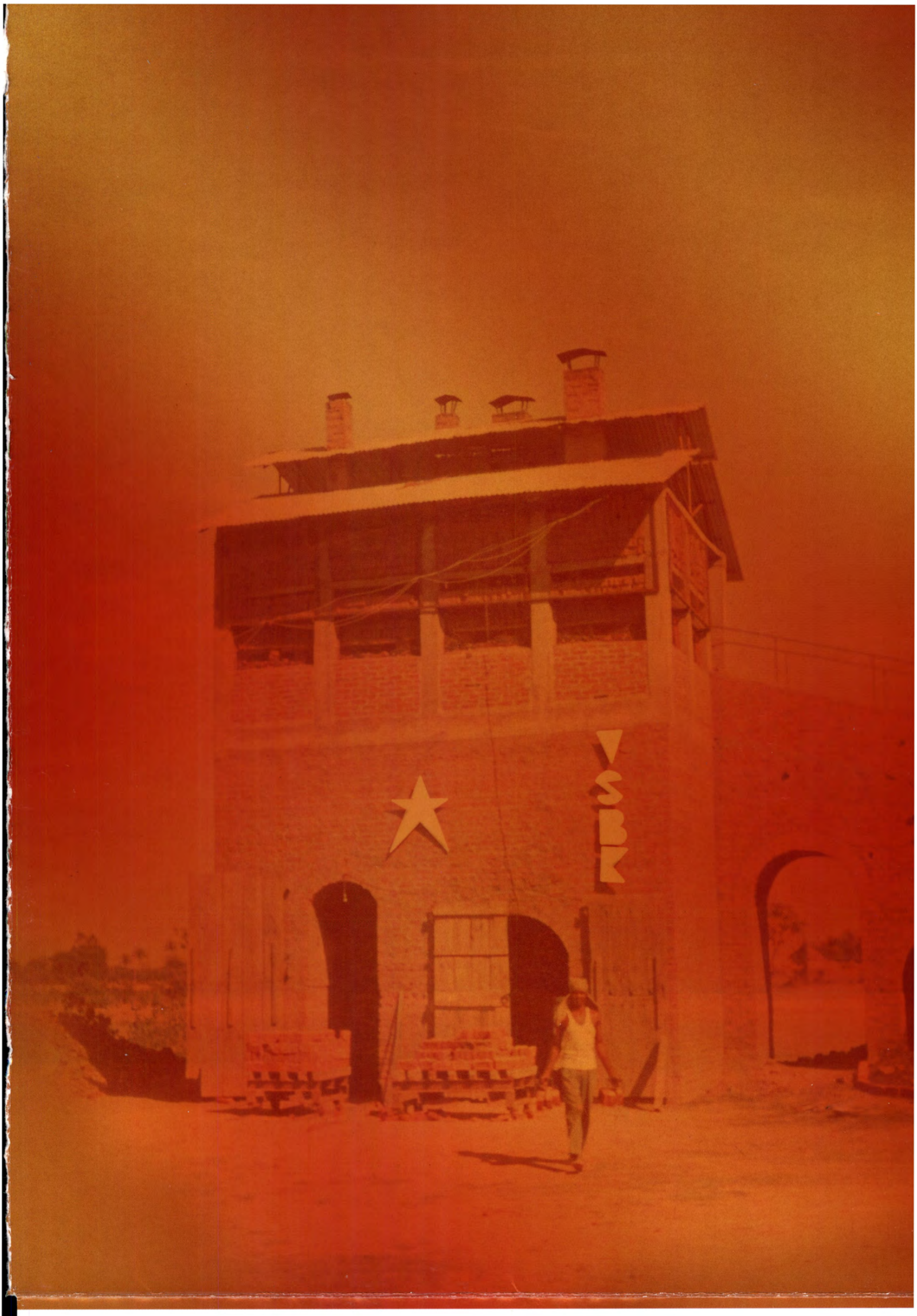
The third VSBK kiln was built in association with Comtrust, a leading fired clay product manufacturer in South India. The product quality was significantly better than the output of the earlier kilns. Innovations such as mechanized hoisting of bricks were introduced for commercial production of bricks. A positive outcome was that Comtrust constructed two additional shafts to enhance the production capacity of the VSBK to 12,000 bricks a day. This kiln provided the first information for commercial brick production with a VSBK.

The fourth VSBK was built in Pune, (Maharashtra) in West India where the soil quality is very poor but the market demand for bricks is very high. This VSBK was constructed in association with clamp owners. The shaft sizes were 1m x 2m and 1.25m x 2m. Operational dificulties have been experienced with such large shaft sizes.

The first commercial scale operation was launched with the fifth VSBK at Gwalior in Central India. The kiln was initially built with twin shafts; the addition of two more shafts subsequently led to a production capacity of 16,000 bricks per day from the 4 shafts, each measuring 1m x 2m.

More commercial VSBK units have followed.

All commercially operated VSBKs have provided significant insights concerning the requirements of entrepreneurs, especially with respect to market conditions. Based on the initial practical working experience of the kilns built in India, important lessons have been learnt.


VSBK