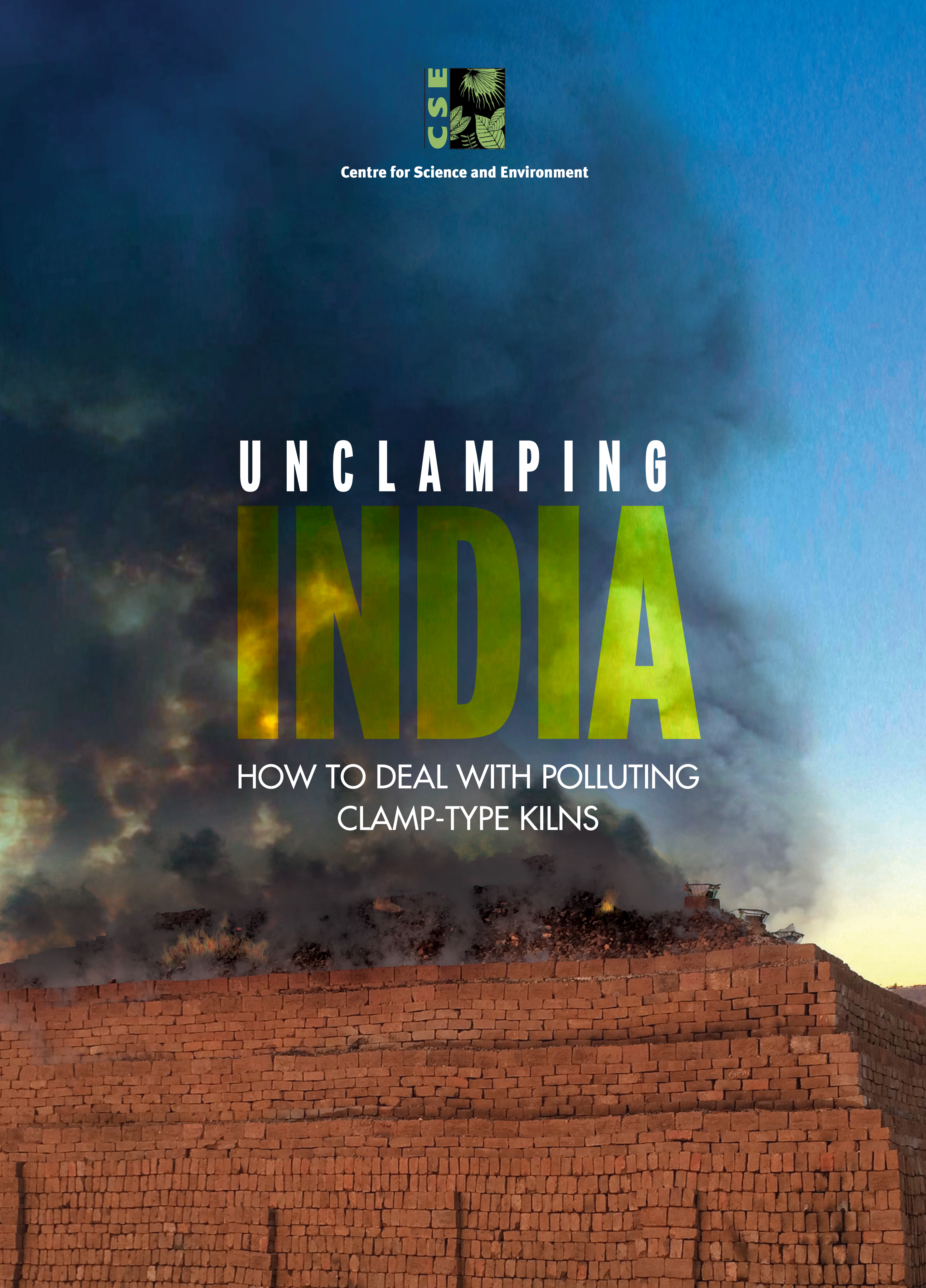
Centre for Science and Environment

UNCLAMPING INDIA

HOW TO DEAL WITH POLLUTING CLAMP-TYPE KILNS



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An initiative supported by

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Citation: Rahul Kumar and Nivit Kumar Yadav 2018, *Unclamping India: How to deal with polluting clamp-type kilns*, Centre for Science and Environment, New Delhi

Published by
Centre for Science and Environment
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Printed at Multi Colour Services

"For private circulation only"

UNCLAMPING INDIA

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1. Introduction

Brick making in clamps is one of the oldest technologies in the world, as also in India. A clamp is the most basic type of a brick kiln. It essentially consists of piles of green bricks interspersed with combustible material. No permanent structure is required, which lowers the initial infrastructural cost and does away with any maintenance cost. The technology used in the making of a clamp and to fire bricks inside it is simple and easily replicable. Clamps are, therefore, an attractive financial and technological option for making bricks.

However, clamps employ one of the least efficient and most polluting brick-making technologies. Zigzag kilns produce about 85 per cent good quality bricks; in comparison clamps only produce 50 per cent good quality bricks. The architecture of a clamp does not allow very efficient use of fuel, resulting in higher emissions from incomplete combustion. Specific energy consumption of clamps is almost double (2.10 mJ/kg fired bricks) that of zigzag kilns (1.10 mJ/kg fired bricks). Moreover, clamps do not have emission dispersal mechanisms like stacks; therefore, the emissions stay at the surface level. This becomes a serious nuisance if the clamp site is near a residential area or an environmentally sensitive zone like a water body or major road. It also increases the health risks for the brick-making labourers.

According to the Punjab State Council for Science and Technology, there are more than 90,000 energy-inefficient clamps operating in India.[1] As the country strives towards a cleaner brick future, phasing clamps out is a necessary step on the way. However, policy makers have been largely oblivious to this smoke-bellowing problem. Clamps have escaped the attention in the brick kiln standards in the Environment (Protection) Seventh Amendment Rules, 2009 and the draft Environment (Protection) Amendment Rules, 2018. On the one hand, the Ministry of Environment, Forest and Climate Change (MoEF&CC) and Central Pollution Control Board (CPCB) are pushing all kilns in the country to switch to cleaner technology while on the other hand, regulations like the Maharashtra Clamp-type Traditional Brick Kilns (Siting Criteria for Establishment) Rules of 2016 are being allowed to be made for such polluting technologies at the state level. This policy contradiction must go.

CSE has carried out this survey of clamps in western Maharashtra. Brick making in the area takes place only through clamp-type kilns, though in eastern parts of Maharashtra (areas near Nagpur) other brick making technologies such as FCBTK have taken root. The region is considered the hub of clamps in the state.

We hope that the insights provided by this survey will be useful to direct official focus on clamps to help phase them out in a smooth and time-bound manner.

1 Punjab State Council for Science and Technology. Available at http://www.pscst.gov.in/pscstHTML/brick.html, as accessed on 18 April 2018

2. Background: Policies and regulations on clamps

Brick sector is a very energy- and resource-intensive sector, in addition to being highly polluting. Firing clay bricks has three big inherent environmental issues:

1. Use of topsoil as raw material
2. Stack or fugitive emissions
3. Use of inefficient or labour-intensive technologies.

India, being the second largest producer of clay-fired bricks in the world, is also considered to be one of the major air emission contributors from this sector.

To curb pollution from this sector, MoEF&CC has devised various policies from time to time. However, none of the policies have mentioned anything about clamp-type kilns. Even the draft notification by MoEF&CC proposed in 2015 (and still not notified) for brick kilns has no information regarding clamps.

NGT cases

Odisha

The Odisha State Pollution Control Board had filed an application to Eastern Zone Bench, which sits in Kolkata, of the National Green Tribunal (NGT) on 27 May 2016, seeking clarification regarding the Tribunal's order dated 7 April 2016 where the pollution board had been directed to take action against illegal brick kilns operating in the state. The Board had submitted that the state had different type of kilns (clamps, moving chimney Bull's trench kilns and fixed chimney Bull's trench kilns: FCBTKs), however, the Board was dealing with only FCBTKs since they were the only type of kiln permissible under law. The Board had also underlined its confusion regarding action to be taken against the other two types (clamps and moving chimney) as their legal status was unclear.

NGT directed the Board to serve closure notice to all brick kilns, including clamps and moving chimney type, if operating without obtaining necessary consent.

Maharashtra

A writ petition was transferred to the Western Zone Bench, which sits in Pune, of the NGT by the Bombay High Court Bench at Aurangabad through an order dated 1 October 2013. The petition was against a traditional-type clamp brick kiln unit operating without any permission from regulatory authorities. The petitioner complained that the kiln was in the middle of a residential area and pollution from its operation was a threat to life and health of the inhabitants of the area. Additionally, it was alleged, the smoke from the clamp had also damaged crops in the surrounding areas. The complainant had also informed the Court that authorities had not taken suitable action against the clamp in spite of repeated complaints made by the petitioner and other people of the locality.

During the course of the hearing, the Tribunal heard the different parties involved. The Maharashtra Pollution Control Board (MPCB) was also a party to the dispute and appeared in front of the Tribunal time and again, as required. The MPCB informed the Tribunal that its role was restricted to monitoring air emissions and looking into the complaints of air pollution with respect to brick kiln activities. It contended that the revenue department of the state was responsible for granting consent to establish and non-agricultural use of the land. Apart from this, permissions from District Health Officer, Zila Parishad and Gram Panchayat were also required.

The Tribunal inquired about the CPCB direction of 4 June 2002 to state pollution control boards (SPCBs) to classify industries into three categories and expressed its desire to know under which category the brickfields were classified in Maharashtra. In its reply, the MPCB stated that brickfields were categorized under orange category in the state and require consent under Water and Air Pollution Acts.

Since this meant that brickfields were an industry within the definition of the classification, the MPCB had to change its stand completely. Subsequently, it directed all of its regional and sub-regional officers to cover such types of activities under its consent management mechanism by circulating the CPCB directions. The MPCB directions further stated that brick kilns not operating under an express consent to operate would be shut down.

But consent to operate mechanism requires certain emission standards and the need for particular air pollution control systems. The Tribunal asked the MPCB how it intended to enforce the consent to operate mechanism (and thereby the CPCB guidelines) without such standards and requirements in place. This line of inquiry of the Tribunal underlined the necessity of stipulating air emission standards and other conditions for safeguarding the environment for the implementation of the MPCB's decision to cover brick kilns under consent management mechanism.

The important question which came up before the Tribunal was whether any standards are prescribed for traditional clamp-type brick kilns. Based on this, the MPCB was directed to prepare suitable rules for clamps and, if any such standards have already been framed by the CPCB or any other state, the MPCB may consider adopting the same by following due process of law.

Maharashtra Pollution Control Board's Guidelines

MPCB, acting upon the directives issued by the Western Zone of NGT, has notified guidelines for establishment of clamp-type kilns on 26 August 2016, and they are called the Maharashtra Clamp-type Traditional Brick Kilns (Siting Criteria for Establishment) Rules, 2016 (see *Annexure 1*). However, the guidelines have a few gaps which can lead to confusion among manufacturers during implementation:

1. The guidelines provide siting criteria but do not specify how brick making

in the state can be made cleaner and environment friendly.

2. The notification mentions that clamps with a batch size of more than 50,000 bricks will have to adhere to the MoEF&CC notification for brick kilns issued on 22 July 2009 (see *Annexure 2*) and the National Ambient Air Quality Standards issued on 18 November 2009 (see *Annexure 3*), whereas clamps with batch size of less than 50,000 need to comply only with the National Ambient Air Quality Standards. The interesting part to note here is that the 2009 MoEF&CC notification mentions only Bull's trench kiln, down draught kiln (DDK) and vertical shaft brick kiln (VSBK) and does not have anything about clamp-type kilns. Therefore, it is unclear which standards should be followed for clamps. It is also possible that bigger clamps will start downsizing to batch sizes of less than 50,000 to avoid the regulatory net.
3. Utilization of waste in brick making has not been addressed and use of internal fuel has not been made mandatory.
4. The guidelines further specify the minimum distance of establishment of a brick kiln from human settlement, and state and national highways as 200 metre, which should be increased.
5. The guidelines fail to specify anything about the change in design or inclusion of any air emission control systems.

3. Insights from the survey area

What is a clamp and how does it function?

A clamp is the most simple and basic brick making technology. Fundamentally, it consists only of green bricks with space in between for fuel. The green bricks in a typical clamp are stacked in the form of a pyramid which slopes at the sides to provide stability to the structure. The sides and top of the structure are usually covered with burnt bricks for insulation.

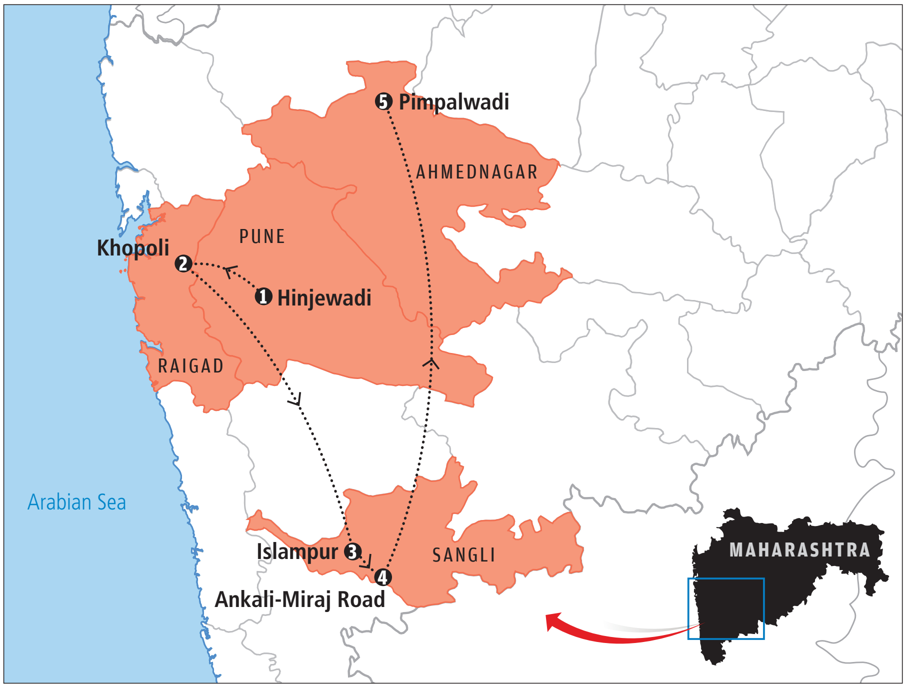
There are usually two or more fuel beds, one below the green bricks and one or more in middle of the structure. Once the clamp is built, the fuel bed at the bottom is ignited. Several types of fuels such as coal, coal powder, agriculture waste and rubber from rejected tyres is used. Holes are made for inflow of air. The rate of burning cannot be easily controlled as it depends on many natural factors such as the speed and direction of wind. However, the covering of burnt bricks with ash at the top can be adjusted to control ventilation and, hence, the burning rate. During burning, heat rises through the bricks and fumes and smoke are released from the top of the clamp.

The firing process is generally completed in eight–12 days, indicated by the settling of the top of the clamp followed by another week for cooling of the bricks. The quality of bricks varies within a clamp. While the innermost bricks are the hardest, the outer bricks are usually under-burnt. Sufficient inflow of air results in oxidation, imparting red colour to the bricks, while insufficient air supply results in yellow or orange colour. A large clamp of 100,000 to one million bricks has a much better fuel efficiency than smaller clamps because of higher heat loss through the surface.

Arrangement of bricks in a clamp

Over-burnt bricks as waste

Figure 1: Survey area



Source: Adapted from Engineering Survey Maharashtra

Overview of the survey area

To understand the functioning of clamps and their environmental impact better, CSE conducted a survey in the western region of Maharashtra. The survey area included the districts of Pune, Raigad, Ahmednagar, Satara and Sangli as shown in *Figure 1: Survey area*. These districts are considered to be the hub of clamp-type kilns in the state. Perennial rivers such as Krishna, Warana and Koyana flow through this region and deposit good alluvial soil that is suitable for brick making as it requires less amount of coal for burning. Bricks from this region are popular within the state for their good quality. However, this is a very fertile area and any excavation of high quality fertile soil results in loss of agricultural productivity.

The following case studies were chosen because they are clamp sites close to metropolitans of western Maharashtra or major upcoming cities of the region. These sites were also chosen for their proximity to residential areas, and environmentally sensitive zones like water bodies and major roads.

Hinjewadi, Pune

The region is considered to be the brick supply hub of the urban amalgamation of Pune metropolis. The clamps are trapezoidal in shape and are fired with coal. Coal dust is also used as an internal fuel in the area and is mixed with clay. There are around 20–25 designated clamp spots in the area where clamps are constructed one after the other. The average production from each clamp site is approximately 10 to 15 lakh bricks per year. A summary of information on clamps in the area is presented in *Table 1: Snapshot of the region, Hinjewadi, Pune*.

Table 1: Snapshot of the region, Hinjewadi, Pune

Particulars	Description
Number of clamp sites in the area	20–25
Average number of bricks produced per year	30,00,000
Type of fuel used	Coal, wood and furnace oil
Average fuel consumption per lakh bricks	15–18 tonne
Royalty paid on clay	Rs 10,000 for the amount of clay sufficient to produce 100,000 bricks
Selling price of a 1,000 bricks	Rs 6,000 for normal size Rs 9,000 for double size
Worker wages	Variable
Cost of leasing land per acre per year	Approximately Rs 1,20,000

Source: CSE survey

These kilns are located very close to the Pune–Mumbai expressway and the region is densely populated with residential and institutional areas. As a matter of fact, the closest residential complex is less than 200 m from a clamp site (see *Figure 2: Proximity of a clamp at Hinjewadi to a residential block*. Inmates of the residential society complain about huge black smoke and smell from these kilns. The smoke and smell reaches a peak at the time of firing of the kilns, and abates subsequently. "We have complained about this to the kiln entrepreneurs several times but every time they say they will make sure that this does not occur the next time. We don't know where to complain about them," stated one of the residents.

Figure 2: Proximity of a clamp at Hinjewadi to a residential block

Source: Adapted from Google Earth

Piles of ready bricks were stacked around at each site with a *munshi* to deal with the customers. Yet the manufacturers were complaining about unavailability of raw material. One manufacturer informed the survey team that the manufacturers' association had met the district collector of the region to seek permission for de-silting of the Mulshi Dam. This would not only help in rejuvenating the dam but will also ensure a steady supply of raw material to the brick entrepreneurs for at least three years. However, a decision regarding this had not been taken so far.

Oddly, clay bricks in the region are only produced using clamp technology. None of the more advanced technologies has been introduced.

Khopoli

Khopoli is a small town in the Raigad district of Maharashtra, situated at the base of the Sahyadri mountains. It has recently been declared an industrial area by the government. Owing to the corresponding developments in the cities around it, the area has developed into one of the major brick manufacturing hubs in the state. Its proximity to big cities like Pune and Mumbai, which are at an approximate distance of 80 and 75 km respectively, has also helped brick entrepreneurs in the region.

The main crop of the Raigad district is rice, as a result rice husk is used as secondary fuel in the region, though coal remains the first choice of kiln owners. Coal is procured from the Chandrapur district and costs around Rs 8,500 per tonne and rice husk Rs 2,000 per tonne.

Around 10–15 trapezoidal clamp-sites are functional in this region and the average annual production from each clamp site is approximately 10–15 lakh bricks. A summary of information about the clamps in the area is presented in *Table 2: Snapshot of the region, Khopoli*.

Table 2: Snapshot of the region, Khopoli

Particulars	Description
Number of clamp sites	10–15
Average number of bricks produced per year	1,500,000
Type of fuel used	Coal and rice husk
Average fuel consumption per lakh bricks	16–18 tonne (10–11 tonne coal and the rest rice husk)
Royalty paid on clay	Rs 16,500 for 100 brass (One brass is enough to produce approximately a 1,000 bricks)
Selling price of 1,000 bricks (without transportation)	Rs 3,500 for normal size Rs 5,500 for double size
Worker wages	Variable
Cost of leasing land per acre per year	Approximately Rs 30,000–40,000

Source: CSE survey

A clamp next to a road in Khopoli

A typical clamp in the area producing around 3–4 lakh bricks per batch

These clamp sites are located on the old Pune–Mumbai highway and the region supplies bricks to the adjoining areas of Mumbai such as Panvel, Kalyan etc. Shilphata and Atkargaon, and adjoining areas like Vavoshi etc., are the kiln hotspots.

Most entrepreneurs in the region are aware of VSBK technology for brick manufacturing. Indian Institute of Technology (IIT), Bombay developed a VSBK kiln as a pilot-scale study. However, the kiln did not remain operational for long. "You can see the fate of the VSBK kiln established by IIT, it has not been successful, then why should we adopt the technology," one of the kiln owners argued. "Either the MPCB or the state government should take an initiative and demonstrate successful operation of new technology in our region or state, only then will we be motivated to switch over to new technology. Otherwise, it is risky to invest huge capital on unproven technologies," he further suggested.

When the survey team enquired about the clearance obtained from the MPCB, the entrepreneurs informed us that till now they have not taken any clearance from the MPCB and are not aware of recent notifications published by the Board. "If required, we will start obtaining the clearance from the next season. Till now, we have not faced any problem from local residents. I don't know why the issue of pollution from clamps is highlighted so much when there is little emission into the atmosphere. Most of the particles settle down in the clamp itself," defended one of the entrepreneurs.

Islampur

Islampur, a municipal council in the Sangli district, is equidistant from three major cities—Karad, Sangli and Kolhapur—and is just a few kilometers off the major highways connecting these cities. For this reason, it is becoming favourable for Islampur to cater to trade and business. The region is dominated by the Kumbhar community and most of them are into the brick making business.

There are around 150 clamp-sites in the region, with an equal percentage of small and large manufacturers. The area produces over 80 million bricks annually, in which large and small manufacturers contribute approximately 10–15 lakh and 1.5–2 lakh bricks respectively. Baggase, rice husk and coal dust are used as internal fuel and are added in the proportion of 15–20 per cent to the bricks. Since the region is considered to be the sugarcane bowl of Maharashtra due to large number of sugar factories, bagasse is abundantly available to the kilns at a cost of Rs 3,000 per tonne. Coal is brought from Chandrapur or, sometimes, from Bellary, at a cost of Rs 7,000 per tonne, including transportation cost. Wood (used to initiate fire) costs Rs 4,500 per tonne. Maharashtra government allows the Kumbhar community to take upto 500 brass of clay annually free of cost. Clay is procured gratis 30 km from the region from the banks of river Krishna in Itkare Gaon. Only the transportation cost has to be borne by the manufacturers. A summary of information about the clamps in the area is presented in *Table 3: Snapshot of the region, Islampur*.

Small and large manufacturers in the region are at odds with each other. Owners of small units complain that the bigger players try to hinder their business so that they are forced to join bigger units as workers.

A small-scale unit is categorized as family business as the owners and their families perform all the work during brick manufacturing. "This is our family business and every member of the family contributes in one or the other activity of brick making from the preparation of clay to setting of dry green bricks and firing," explained one of the small clamp owners. "We not only prepare bricks but idols of Ganesha and other earthen products too. The local residents never had any complaints about the operation of the clamp," he added. Clamps are usually located near the clamp owner's house or at the site where bricks are required and use wood for firing of bricks.

Large-scale brick manufacturing in the region is done on a pattern similar to the other parts of the state. They supply bricks to the adjoining areas and the local construction establishment. These kilns are operated on leased land and the labourers are from different states, majorly from Karnataka. Local residents near one of the large clamps complained about the smell and smoke from the

Table 3: Snapshot of the region, Islampur

Particulars	Description
Number of clamp sites	150
Average number of bricks produced per year	82,500,000
Type of fuel used	Coal, wood and baggase
Average fuel consumption per lakh bricks	16–18 tonne
Royalty paid on clay	Rs 400 per brass
Selling price of a 1,000 bricks (without transportation)	Rs 5,000 for normal size
Worker wages	Variable
Cost of leasing land per acre per year	Rs 40,000–50,000

Source: CSE survey

Table 4: Comparison between small and large kilns at Islampur

Particular	Small unit	Large unit
Average number of bricks produced per year	1.5–2 lakh	10–15 lakh
Type of fuel used	Wood	Coal, wood etc.
Workers	Family members	From Karnataka and other states
Land	Use their own land	Leased or rented land
Supply	Nearby community	Adjoining areas and local construction establishment
Clamp size	20,000–25,000 bricks	200, 000–300,000 bricks
Internal fuel used	Coal dust and baggase	Baggase and coal dust

Source: CSE survey

A small-scale clamp. Small-scale clamps produce between 10,000 to 25,000 bricks

Small unit manufacturers prepare idols and bricks near their house

kiln. "At the time of firing, huge amounts of smoke can be seen coming out from the kiln. This slowly abates in a day or two, but a peculiar smell persists for a few more days," informed one of the residents. *Table 4: Comparison between small and large kilns at Islampur* draws a ready-reckoner comparison between the two scales of operation.

Miraj Road, Ankali, Sangli District

Ankali is situated near the banks of river Krishna. Availability of clay, therefore, is not a problem. The region is an established zone for producing bricks. Most of the entrepreneurs have inherited family businesses. With clamps producing upto 500,000, the region is the major supplier of bricks to the nearby Sangli city. A summary of information about the clamps in the area is presented in *Table 5: Snapshot of the region, Miraj Road, Ankali.*

Table 5: Snapshot of the region, Miraj Road, Ankali

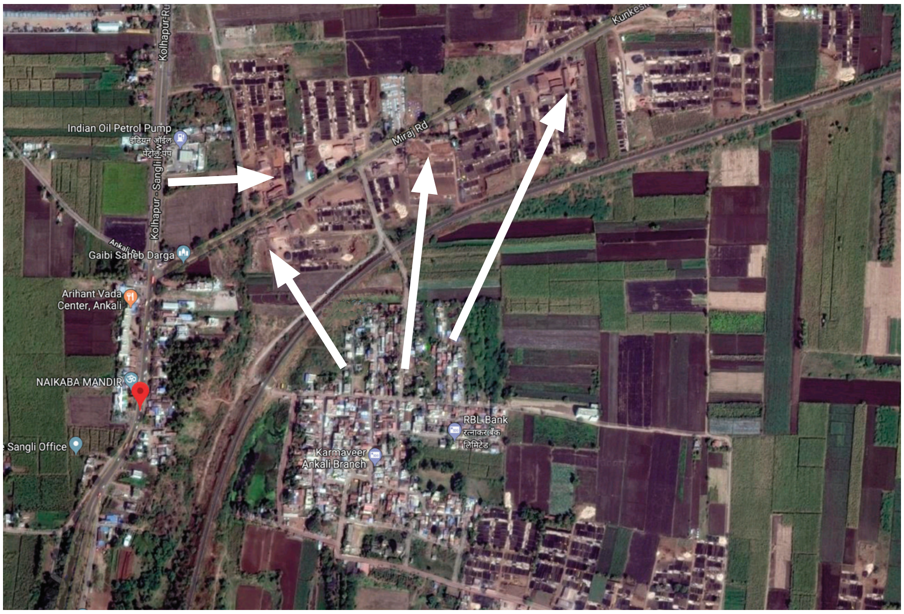
Particular	Description
Number of clamp sites	200
Average number of bricks produced per year	200,000,000
Type of fuel used	Coal, wood and foundry waste
Average fuel consumption per lakh bricks	12-15 tonne
Cost of clay (clay procured from clay contractors)	Rs 500 per brass, including transportation cost
Selling price of a 1,000 bricks (without transportation)	Rs 5,000 for normal size
Worker wages	Variable
Cost of leasing land per acre per year	Approximately Rs 80,000

Source: CSE survey

Fifty clay brass, 7.5 tonne foundry waste and 2.5 tonne fly ash are utilized for making 100,000 green bricks. Using internal fuel and constructing larger clamps reduces the fuel consumption a fair bit. Coal remains the primary fuel for firing clamps and is procured from Bellary, Chandrapur and Goa. Foundry waste is also sourced from Goa. The cost of coal varies from Rs 6,500 to Rs 7,500 a tonne, and foundry waste costs Rs 2,500 a tonne, excluding transportation.

These kiln-sites are adjacent to the Kolhapur–Sangli highway and a large number of such kilns are located on the side of Miraj Road, Ankali (see *Figure 3: Location of clamps at Miraj Road, Ankali*). A big residential area is situated less than 200 m from the clamp cluster, which is again a violation of the MPCB norms.

Figure 3: Location of clamps at Miraj Road, Ankali



Source: Adapted from Google Earth

Clamps next to a road in Miraj Road, Ankali

A clamp near a water body

Pimpalwadi, Shirdi

Pimpalwadi is located five–six kilometers from Shirdi. The bricks from the region are considered to be of superior quality with a smooth finish. The fineness of the bricks comes from the use of fly ash mixed with clay. The fly ash is sourced from a 910 MW coal-based power plant located in Nashik.

Bricks are prepared using 40 per cent fly ash, 45 per cent clay, 5 per cent coal powder and 10 per cent baggase, thus reducing the amount of clay and coal needed significantly. Utilization of fly ash in brick manufacturing is good but the cause of concern is the way it is being handled by the manufacturers. There is no designated place to store fly ash. This causes a lot of nuisance in the surroundings. The residents around the kiln complained that during the transportation (loading and unloading) of fly ash, the whole area becomes white due to the discharge of fly ash into the atmosphere and the manufacturers have not taken appropriate measures to suppress this discharge.

Most of the entrepreneurs in the region are large-scale manufacturers. On an average, a clamp site in the region produces 200,000 to 300,000 bricks a year. Clay is procured mainly from contractors, but even nearby farmers dig their fields upto five–ten feet and sell the clay to brick manufacturers. Wood is used to initiate the fire in the kiln while coal remains the primary fuel for firing. Coal is brought from Chandrapur district and costs around Rs 7,500 a tonne, including transportation. Procurement of fly ash from Nashik costs around Rs 400 per tonne, baggase Rs 4,000 per tonne, and coal powder (procured from Bellary) Rs 2,700 per tonne.

These clamp sites are located in the vicinity of human habitation. One of the kiln sites is situated in front of a residential locality, which lies just across the road. The kiln sites are strung together in the form of a cluster, and their cumulative impact on the air quality could be worse. A summary of information about the clamps in the area is presented in *Table 5: Snapshot of the region, Pimpalwadi*.

Table 6: Snapshot of the region, Pimpalwadi

Particular	Description
Number of clamp sites	80
Average number of bricks produced per year	160,000,000
Type of fuel used	Coal, wood, baggase and fly ash
Average fuel consumption per lakh bricks	9–10 tonne
Royalty paid on clay	Rs 11,000 for 100 brass
Cost of clay (clay procured from nearby farmers)	Rs 500–600 per tractor (approximately 1.5 brass)
Rate of 1,000 bricks (without transportation)	Rs 4,500 for normal size
Worker wages	Variable
Cost of leasing land per acre per year	Approximately Rs 40,000

Source: CSE survey

A large-scale clamp. Typically, they produce between 5–10 lakh bricks per batch

A clamp in close proximity to a residential area

AMBIENT AIR QUALITY MONITORING NEAR CLAMPS

TERI has performed a study for CPCB on clamp-type kilns and prepared a report titled *Evaluation and improvement in design for clamp kilns for brick manufacturing (cleaner production), good practices, practicable energy conservation measures and environmental standards thereof*. The study was conducted to monitor the performance and emissions of clamp kilns operating in different states. Emission results obtained are tabulated in the following table.

Location (state)	Kiln no.	Production capacity (lakh fired bricks)	Specific energy consumption (MJ/kg fired bricks)	Day of monitoring	24-hour average values of			
					Suspended particulate matter (μg/m^3)	Respirable suspended particulate matter (μg/m^3)	SO_2 (μg/m^3)	NO_2 (μg/m^3)
Indore (Madhya Pradesh)	Kiln 1	2.0	3.15	Firing day	608	312	8	23
				Normal day	395	170	9	22
	Kiln 2	1.75	2.95	Firing day	255	186	8	25
				Normal day	223	170	9	24
Patancheru (Andhra Pradesh)—wood firing	Kiln 1	3.5	1.6	Firing day	1,471	392	6	41
				Normal day	303	263	6	32
	Kiln 2	2.25	1.4	Firing day	1,233	418	6	33
				Normal day	266	178	6	25
Patancheru (Andhra Pradesh)—coal firing	Kiln 1	1.25	1.92	Firing day	339	218	6	31
				Normal day	283	226	6	33
	Kiln 2	1.20	1.90	Firing day	274	219	6	33
				Normal day	209	158	6	37
Thitakuddi (Tamil Nadu)	Kiln 1	0.9	2.53	Firing day	2,954	2,099	15	118
				Normal day	497	424	9	57
	Kiln 2	0.5	2.74	Firing day	2,879	1,834	12	89
				Normal day	505	379	8	52
Malur (Karnataka)	Kiln 1	1.4	1.21	Firing day	467	322	7	45
				Normal day	399	233	6	38
	Kiln 2	1.38	1.22	Firing day	580	385	7	46
				Normal day	390	252	6	43
Rajkot (Gujarat)	Kiln 1	2.30	2.06	Firing day	734	494	6	30
				Normal day	1,445	889	6	38
	Kiln 2	1.80	2.05	Firing day	395	306	6	37
				Normal day	395	169	6	31
Raigarh (Maharashtara)	Kiln 1	0.95	1.64	Firing day	554	258	15	174
				Normal day	193	115	9	150
	Kiln 2	0.7	1.96	Firing day	401	242	17	24
				Normal day	270	143	8	16
NAAQS(μg/m^3)					-	100	80	80

- SPM values are much higher in all states on both days.
- RSPM values in all states on both firing and non-firing days are much higher than NAAQ standards.
- SOx values in all states on both firing and non-firing days are well within the standards.
- NOx values in all states on both firing and non-firing days are well within the standards except Tamil Nadu and Maharashtra where values exceed the standards.

Observations

The important observation and concerns noted during the study, common to almost all regions, are described as below:

- A substantial number of the clamps are situated and operating near human settlements, water bodies and roads.
- Brick manufacturers have not obtained any clearance from the MPCB and are also not aware of guidelines governing the operation of brick kilns.
- Most labour is out-station and works in a kiln only for six–seven months (between November and May) every year, returning to their homes for the rest of the year. Wages are paid on a piece-rate basis, ensuring the workers toil hard to make and transport bricks. Some kiln owners even make advanced payments. However, currently, the kiln owners are facing a labour crisis as the workers do not want to leave their homesteads for such arduous work. At some places, workers did not show up even after receiving advance payments.
- Another problem that the manufacturers complained about is the irregular supply of good quality clay which has created uncertainty in their minds regarding the business. However, the survey team observed that all kilns had huge amounts of stocked clay.
- Most brick kilns are operating on leased land and, thus, the owners do not want to invest too much in technology and infrastructure. They assert that they cannot even seek loan from banks if operating on leased land.
- The kiln owners do not want to adopt any new technology since there is no incentive from government for the same. Also, the uncertainty about future regulatory norms holds them back from investing.
- Manufacturers admit that lack of understanding of new technologies is also a reason for their resistance to switching to cleaner options. They suggest that if the government can successfully demonstrate the operation of new technology in their region, they will consider the transformation of their kilns.
- Entrepreneurs fear the competition from clamp owners who have not adopted new technologies, but fail to make a link between new technology and better quality of their product which would, in turn, give them a competitive edge.

4. Comparison of clamps and zigzag technology

Clamps are an inefficient way of making bricks. The loss of clay, fuel and water can be gauged from the fact that only 50 per cent of the bricks produced in the clamps are of good quality Class I bricks. In comparison, 80 per cent of bricks produced in zigzag kilns are Class I bricks. Better quality of bricks means more money from their sale. *Table 7: Comparison of revenue generated by a clamp and a zigzag kiln* provides a financial comparison between the two technologies.

From this example, the difference in the number of Class I bricks produced from a clamp and a zigzag kiln is 600,000 per year which results in a huge revenue difference of 24 lakh.

Zigzag kilns also consume considerably less amount of fuel to produce the same number of bricks, resulting in additional savings. To produce 100,000 bricks, a zigzag kiln uses 10 tonnes of fuel, compared to 15 tonnes used by a clamp to produce the same number of bricks. The average price of coal, a primary fuel used in brick making, is Rs 8,000 per tonne. Therefore, the annual savings on coal (in our example of kilns with a capacity of 2,000,000), if the switch is made, come to about Rs 8 lakh. A comparison between the two technologies on the basis of coal consumption is tabulated in *Table 8: Comparision between a clamp and a zigzag kiln on coal consumption*.

To conclude, if a switch is made from clamp to zigzag technology, a kiln operator can save upto a total of Rs 32 lakh per year from increase in the number of Class I bricks and decrease in fuel consumption.

Table 7: Comparison of revenue generated by a clamp and a zigzag kiln

Type of kiln	Total bricks produced	Class I bricks		Sale price per 1,000 bricks (in Rs)	Revenue generated (Rs)
		Per cent	No.		
Clamp	2,000,000	50	1,000,000	4,000	40 lakh
Zigzag	2,000,000	80	1,600,000	4,000	64 lakh

Source: CSE

Table 8: Comparison between a clamp and a zigzag kiln on coal consumption

Type of kiln	Total bricks produced	Coal consumption (in tonnes)		Price of coal (in Rs per tonne)	Total expenditure on coal (Rs)
		Per lakh of bricks	Total		
Clamp	2,000,000	15	300	8,000	24 lakh
Zigzag	2,000,000	10	200	8,000	16 lakh

Source: CSE

The cost in switching to zigzag technology includes cost of labour, equipment and construction material including bricks. The manufacturers can use their own bricks for the switchovers or upgrades. So the initial investment required would be around 10 to 12 lakhs. This initial cost can be easily recovered in one brick making season.

COMPARISON OF CLAMPS WITH OTHER TECHNOLOGIES

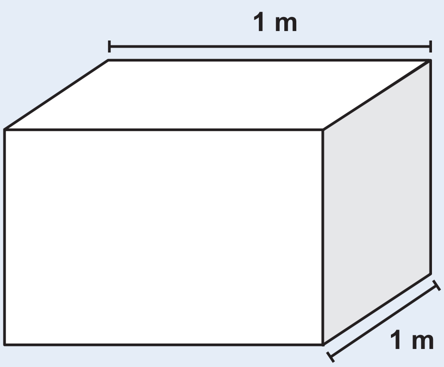
It is clear from the table that specific energy consumption (SEC) of clamps is much higher compared to other brick making technologies. The savings in natural resources can be figured out from the percentage of good quality bricks, which is 50 per cent for clamps and around 80 percent from zigzag kilns.

The SEC of larger clamps is lower as compared to smaller clamps, though it is on the higher side as compared to other technologies. This is basically because the heat loss from the surface is reduced in larger clamps. The heat loss ratio is directly proportional to surface to volume ratio and keeps on reducing as the size of the clamp increases. For example, a surface to volume ratio of a clamp with dimensions of 1 m x 1 m x 1 m will be 5 whereas it is reduced significantly and is equal to 1.67 for a clamp with dimensions of 3 m X 3 m X 3 m.

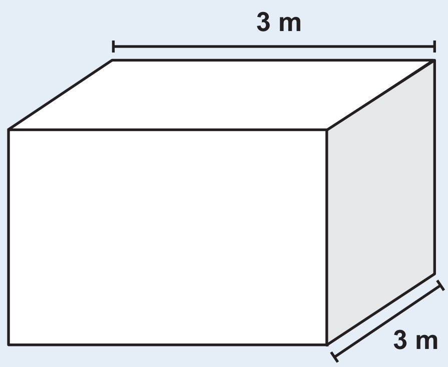
Comparing kilns on different parameters

Parameters	Clamps	DDKs	FCBTKs	Zigzag (natural)	Zigzag (induced fan)	VSBKs	HHKs	Tunnel
Capital cost (US $)	NA	20,000–30,000	50,000–80,000	50,000–80,000	50,000–80,000	60,000–80,000	600,000–650,000	10,00,000
Production capacity (bricks million per year)*	0.01–0.2	0.02–0.04	3-8	3-8	2.5-6	1.5-3	15-18	15
Specific energy (mj/kg of fired brick)	2.10	2.97	1.30	1.06	1.03	0.8	1.20	1.4
Emission CO_2 (gm/kg of fired brick)	NA	282.4	131	105	105	70.5	100	166.3
Black carbon (gm/kg of fired brick)	NA	0.29	0.13	0.01	0.02	0.001	NA	0.0
PM (gm/kg of fired brick)	NA	1.56	1.18	0.22	0.24	0.15	0.29	0.24
CO (gm/kg of fired brick)	NA	5.78	2.00	0.29	1.62	1.84	NA	3.31
Per cent of good quality product	50	85	60	85	80	90	90	95

*NA: Not available; *Per batch in case of clamps and DDKs*
Source: Factsheets about brick kilns in South and South East Asia, A report by Greentech Knowledge Solution Private Limited, 2014



$\frac{\text{Surface area}}{\text{Volume}} = \frac{1 \times 1 \times 5 \text{ (number of surfaces open)}}{1 \times 1 \times 1} = \frac{5}{1}$



$\frac{\text{Surface area}}{\text{Volume}} = \frac{3 \times 3 \times 5 \text{ (number of surfaces open)}}{3 \times 3 \times 3} = \frac{45}{27} = 1.67$

5. Conclusions

Issues and challenges

Clamps are a grossly polluting and inefficient brick making technology, but they are widely used since the initial cost of setting up a clamp is very little, as it does not have any fixed structure. It is also difficult to enforce regulations on these kilns, which can literally be moved from one place to another. Different studies and surveys conducted on clamp-type kilns have highlighted the following issues:

- Specific energy consumption is highest in clamps compared to other brick-making technologies employed in the country.
- The loss in terms of over- and under-burnt bricks is huge. The number of good quality bricks produced is only about 50 per cent.
- Clamps hardly follow any siting guidelines and are usually located in the vicinity of residential area, highways or water bodies in order to have easy access to the market for the finished product and easy availability of the raw material, causing nuisance to nearby inhabitants and adding to the pollution load in environmentally sensitive zones.
- Clamps do not use any air pollution control mechanism; the green bricks are simply stacked and set on fire which results in huge emissions.
- The heat loss from the surface of a clamp is very high, thereby resulting in higher amount of fuel consumption.
- In the absence of proper engineering practices, there is incomplete combustion of fuel, which results in emission of large amounts of black carbon.
- Getting clamps under the regulatory radar is very difficult for the agencies as clamps are not housed within any permanent structures.

Brick manufacturing in India has been paid very little attention, despite it being resource- and labour-intensive, as well as having poor environmental performance record. Considering the huge environmental impact of clamp -type kilns in terms of energy inefficiency, contribution to green house gases as well as black carbon emissions, and loss of other natural resources, this so-called informal sector needs to be formalized and given the shape of a proper industry. The formalization of clamps as an industry will not only have to be focused on reduction of emissions but should also take into consideration the loss of invaluable natural resources.

Recommendations

Considering these issues and challenges, a roadmap for clamp-type kilns in Maharashtra and elsewhere in the country has become the need of the hour. CSE had classified clamps into two groups on the basis of use and made a separate set of recommendations for environment friendly operation of each group:

1. Non-commercial clamps

A unit is considered non-commercial if it manufactures bricks for the personal use of the clamp operator. The typical batch size of these units is generally 10,000 to 25,000. They use agricultural waste as internal fuel, and wood and wood-based charcoal as the main fuel. The SEC of this type of kiln is very high—in the range of 2–3 MJ per kg of fired bricks. Labour is provided by family members and the kiln is usually located at a place where the bricks are needed.

Switching to other brick making technology immediately is not feasible for these clamps and, thus, a period of three years, i.e., till 2020, should be provided to them. Meanwhile, to improve the environmental performance of these kilns, the following measures can be enforced:

- Such clamps should make use of some kind of removable enclosures which can be refitted in other clamps to reduce the SEC and increase efficiency.
- Flue gases from the enclosed clamp should be channelized through a chimney to reduce the concentration of emissions. Stack height can be decided according to the batch size of the clamp.
- There should be internal fuel and waste mixing in the clay preparation while making green bricks.
- There should be multi-layer fuel placement while stacking green bricks.
- To reduce fugitive emissions, a mobile water sprinkling system should be utilized. The area around the clamp should also be paved to avoid pollution due to dust.

2. Commercial clamps

Commercial clamps are those units which have a batch size of 25,000 to 1,000,000 bricks and the annual production is in the range 1.5 lakh to 10 million, depending upon the demand. Bricks are supplied not only to the local area but also cater to the need of bigger construction establishments and builders. The SEC of this type of kilns is also on the higher side, ranging between 1.5–2.8 MJ per kg of fired brick.

Considering the environmental impact of these kilns, it has become necessary for such kilns to switch to a cleaner technology like zigzag. This transition should be enforced strictly.

Annexures

1. MPCB guidelines for establishment of clamps

MAHARASHTRA POLLUTION CONTROL BOARD

Kalptaru Point, 2nd to 4th floor, Near Sion Circle, Sion (East), Mumbai 400 022.

NOTIFICATION

No. MPCB/JD(APC) Section/B-3498.—In exercise of the powers conferred under sub-section (*1*) of section 54 read with clause (z) of sub-section (*2*) of the said section and sub-section (*1*) of section 21 of the Air (Prevention & Control of Pollution) Act, 1981, the State Govt after consultation with the Maharashtra Pollution Control Board hereby notifies the following guidelines for the establishment of clamp type traditional brick kilns in the State of Maharashtra,

THE MAHARASHTRA CLAMP TYPE TRADITIONAL BRICK KILNS (SITTING CRITERIA FOR ESTABLISHMENT) RULES, 2016.

A. Short title and Commencement

1. These Rules may be called as The Maharashtra clamp type traditional Brick kilns (Sitting Criteria for Establishment) Rules, 2016.

2. These Rules will come into force with effect from the date of their publication in the *official Gazette*,

3. The traditional clamp type brick kilns manufacturer having capacity more than 50,000 numbers of bricks per batch of the size 9X4X3" and having capacity 25,000 Nos. per batch of the size 9X4X3" shall obtain consent from the Board, They shall comply with the Notification dated 22nd July 2909 issued by MOEF, GOI and National Ambient Air Quality Standards Dated 18th November 2009,

4. The traditional clamp type brick kilns manufacturer having capacity less than 50,000 numbers of bricks per batch of the size 9X4X3" and having capacity 25,000 Nos. per batch of the size 9X4XB" shall comply with National Ambient Air Quality Standards Dated 18th November 2009.

5. Except the above locations the establishments of the traditional clamp type brick kilns are not allowed in the following locations in the State of Maharashtra.

(*a*) Reserved and Protected Forest, National Parks, Sanctuaries and notified hill stations in the State. Entire Eco-Sensitive Zone/Areas like Matheran, Mahabaleshwar, Pachgani Dahanu, etc. declared under Environment (Protection) Act, 1986 by Ministry of Environment and Forest (MOEF), New Delhi.

(*b*) World Heritage State Sites such as Kass Plateau, Koyana Wildlife Sanctuary, Chandoli National Park, and Radhanagari Wildlife Sanctuary etc, as declared by UNESCO in the State.

(c) Residential areas, as identified after due public consultation will be declared and declared area by concern Municipal corporations / Local Bodies.

B. Fuel pattern to be used in Brick Kilns-

1. Local agro wastes residue shall be encouraged for use as internal fuel to replace coal in a phased manner.

2. Coal of 10 mm size with ash content less than 34 percent shall be used as a fuel in brick Kiln.

3. Industry shall not use any type of explosive chemicals, spent organic, solvent, oily residue, pet coke, filter press cake material, any type of chemicals or waste material covered under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and other waste such as plastic rubber, leather as a fuel in the brick kiln.

C. Implementation of Clamp type Traditional brick Kiln (Location and Establishment) Rules, 2016.

1. The traditional clamp type brick kilns shall be established 200 mtrs. away from the human habitation, having more than 1000 population .

2. The traditional clamp type brick kilns shall be established 200 mtrs. away from the National Highway and State Highway, having more than 1000 population.

This is issued with the approval of the Environment Dept., Government of Maharashtra *vide* letter No. SEAC-2015/Case No.184/TC2, dated 24th August 2016.

Mumbai,
Dated 26th August 2016

Dr. P. ANBALAGAN,
Member Secretary, MPCB.

2. MoEF&CC notification for brick kilns

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 22nd July, 2009

G.S.R.543 (E)—In exercise of the powers conferred by Sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely :—

1. (1) These rules may be called the Environment (Protection) Fourth Amendment Rules, 2009.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule I, for serial number 74, relating to 'Emission Standards for Brick Kilns' and entries relating thereto, the following serial number and entries shall be substituted, namely :—

Sl. No.	Industry	Parameter		Standard
(1)	(2)	(3)		(4)
"74	Brick Kilns	Emission Standards i. Bull's Trench Kiln (BTK)		
			Category*	Limiting concentration in mg/Nm³
		Particular matter	small	1000
			medium	750
			large	750
				minimum (metre)
		Stack height	small	22 or induced draft fan operating with minimum draft of 50 mm WG with 12 metre stack height.
			medium	27 or induced draft fan operating with minimum draft of 50 mm WG with 15 metre stack height.
			large	30 or induced draft fan operating with minimum draft 50 mm WG with 17 metre stack height.
		**Category*	*Trench width (m)*	*Production (bricks/day)*
		small BTK	<4.50	Less than 15,000
		medium BTK	4.50-6.75	15,000-30,000

(1)	(2)	(3)		(4)
		large BTK	above 6.75	above 30,000
		(ii) Down-Draft Kiln (DDK)		
			Category++	*limiting concentration in mg/Nm³*
		Particular matter	small/large/medium	1200
				minimum (metre)
		Stack height	small	12
			medium	15
			large	18
		++*Category*	*Production (bricks/day)*	
		small DDK	Less than 15,000	
		medium DDK	15,000—30,000	
		large DDK	above 30,000	
		(iii) Vertical Shaft Kiln (VSK)		
			*Category***	*limiting concentration in mg/Nm³*
		Particular matter	small/large/medium	250
				minimum (metre)
			small	11 (at least 5.5 m from loading platform)
			medium	14 (at least 7.5 m from loading platform)
		Stack height	large	16 (at least 8.5 m from loading platform)
		***Category*	*No. of shafts*	*Production (bricks/day)*
		small VSK	1—3	Less than 15,000
		medium VSK	4—6	15,000—30,000
		large VSK	7 or more	above 30,000

Notes—

1. Gravitational Settling Chamber along with fixed chimney of appropriate height shall be provided for all Bull's Trench kilns.
2. One chimney per shaft in Vertical Shaft Kiln shall be provided. The two chimneys emanating from a shaft shall either be joined (at the loading platform in case of brick chimney or at appropriate level in case of metal chimney) to form a single chimney.
3. The above standards shall be applicable for different kilns if coal, firewood and/or agricultural residues are used as fuel."

[F. No. Q-15017/35/2007-CPW]

RAJNEESH DUBE, Jt. Secy.

Note.— The principal rules were published in the Gazette of India *vide* number S.O. 844 (E), dated the 19th November, 1986 and subsequently amended *vide* S.O. 433(E), dated the 18th April, 1987; S.O. 64(E), dated the 18th January, 1988; S.O. 3(E), dated the 3rd January, 1989; S.O. 190(E), dated the 15th March, 1989; G.S.R. 913(E), dated the 24th October, 1989; S.O. 12(E), dated the 8th January, 1990; G.S.R. 742(E), dated the 30th August, 1990; S.O. 23(E), dated the 16th January, 1991; G.S.R. 93(E), dated the 21st February, 1991; G.S.R. 95 (E), dated the 12th February, 1992; G.S.R. 329 (E), dated the 13th March, 1992; G.S.R. 475(E), dated the 5th May, 1992; G.S.R. 797(E), dated the 1st October, 1992; G.S.R. 386(E), dated the 28th April, 1993; G.S.R. 422(E), dated the 19th May, 1993; G.S.R. 801(E), dated the 31st December 1993; G.S.R. 176 (E), dated the 3rd April, 1996; G.S.R. 631(E), dated the 31st October, 1997; G.S.R. 504 (E), dated the 20th August, 1998; G.S.R. 7(E), dated the 2nd January, 1999; G.S.R. 682(E), dated the 6th October, 1999; G.S.R. 742(E), dated the 25th September, 2000; G.S.R. 72(E), dated the 6th February, 2001; G.S.R. 54 (E), dated the 22nd January, 2002; G.S.R. 371(E), dated the 17th May, 2002; G.S.R. 489 (E), dated the 9th July, 2002; S.O. 1088(E), dated the 11th October, 2002; G.S.R. 849(E), dated the 30th December, 2002; G.S.R. 520(E), dated the 1st July, 2003; G.S.R. 92(E), dated the 29th January, 2004; G.S.R. 448(E), dated the 12th July, 2004; Corrigenda G.S.R. 520 (E), dated the 12th August, 2004; G.S.R. 272 (E), dated the 5th May, 2005; G.S.R. 315(E), dated the 16th May, 2005; G.S.R. 546(E), dated the 30th August, 2005; G.S.R. 46(E), dated the 3rd February, 2006; G.S.R. 464(E), dated the 7th August, 2006; G.S.R. 640(E), dated the 16th October, 2006; G.S.R. 566(E), dated the 29th August, 2007; G.S.R. 704 (E), dated the 12th November, 2007; G.S.R. 186(E) dated the 18th March, 2008; G.S.R. 280(E), dated the 11th April, 2008; G.S.R. 344(E), dated the 7th May, 2008; G.S.R. 414 (E), dated the 30th May, 2008; G.S.R. 481(E), dated the 26th June, 2008; G.S.R. 579 (E), dated the 6th August, 2008; G.S.R. 600(E), dated the 18th August, 2008; G.S.R. 752(E), dated the 24th October, 2008; G.S.R. 97(E) dated the 18th February, 2009; G.S.R. 149(E), dated the 4th March, 2009; and G.S.R. 512(E), dated the 9th July, 2009.

Printed by the Manager, Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

3. National Ambient Air Quality Standards

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 16th November, 2009

G.S.R. 826(E).— In exercise of the powers conferred by section 6 and section 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:—

1. (1) These rules may be called the Environment (Protection) Seventh Amendment Rules, 2009.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986 (hereinafter referred to as the said rules), in rule 3, in sub-rule (3B), for the words, brackets, figures and letters, "in columns (3) to (5) of Schedule VII", the words, brackets, figures and letters "in columns (4) and (5) of Schedule VII" shall be substituted.

3. For Schedule VII to the said rules and entries relating thereto, the following Schedule and entries shall be substituted, namely:—

"[SCHEDULE VII]
[See rule 3(3B)]
NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual* 24 hours**	50 80	20 80	- Improved West and Gaeke -Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual* 24 hours**	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual* 24 hours**	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual* 24 hours**	40 60	40 60	- Gravimetric - TOEM - Beta attenuation

(1)	(2)	(3)	(4)	(5)	(6)
5	Ozone (O_3) µg/m³	8 hours** 1 hour**	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb) µg/m³	Annual* 24 hours**	0.50 1.0	0.50 1.0	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide(CO) mg/m³	8 hours** 1 hour**	02 04	02 04	- Non Dispersive Infra Red (NDIR) spectroscopy
8	Ammonia(NH_3) µg/m³	Annual* 24 hours**	100 400	100 400	-Chemiluminescence -Indophenol blue method
9	Benzene (C_6H_6) µg/m³	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m³	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m³	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note.— Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.".

[F. No. Q-15017/43/2007-CPW]

RAJNEESH DUBE, Jt. Secy.

Note.— The principal rules were published in the Gazette of India, Extraordinary vide number S.O.844(E), dated the 19th November, 1986; and subsequently amended vide numbers S.O. 433(E), dated the 18th April, 1987; G.S.R. 176 (E), dated the 2nd April 1996; and were recently amended vide numbers G.S.R. 97(E), dated the 18th February, 2009; G.S.R. 149(E), dated the 4th March, 2009; G.S.R. 512(E), dated the 9th July, 2009; G.S.R. 543(E), dated the 22nd July, 2009; G.S.R. 595(E), dated the 21st August, 2009; and G.S.R. 794(E), dated the 4th November, 2009.

Printed by the Manager, Govt. of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

Clamp-type kilns are the most ancient, inefficient and polluting of brick making technologies. Over the centuries, they have been succeed by a long line of better options. At a time when the world (and India) is looking beyond even the 100-odd years old Bull's Trench Kiln technology and moving towards zigzag and other more efficient ways to fire bricks, clamp-sites continue to pockmark the landscape of many regions of India—not only a reminder of a bygone era but also of the need to take urgent action on the matter.

This survey report by CSE on select clamp-sites in western Maharashtra, a region where clamps continue to be a popular option, provides an on-ground assessment of this archaic technology and establishes a case for its smooth but strict phasing out.

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