Anil Agarwal Dialogue, New Delhe.
March 11, 2015

CASE STUDY FROM VIETNAM:

Experience with Tunnel kiln

Hoang Anh Le, PhD.
Faculty of Environmental Sciences (FES)
VNU University of Science
Vietnam National University (VNU), Hanoi, Vietnam

Contents

1 Current Status of Brick Industy in Vietnam

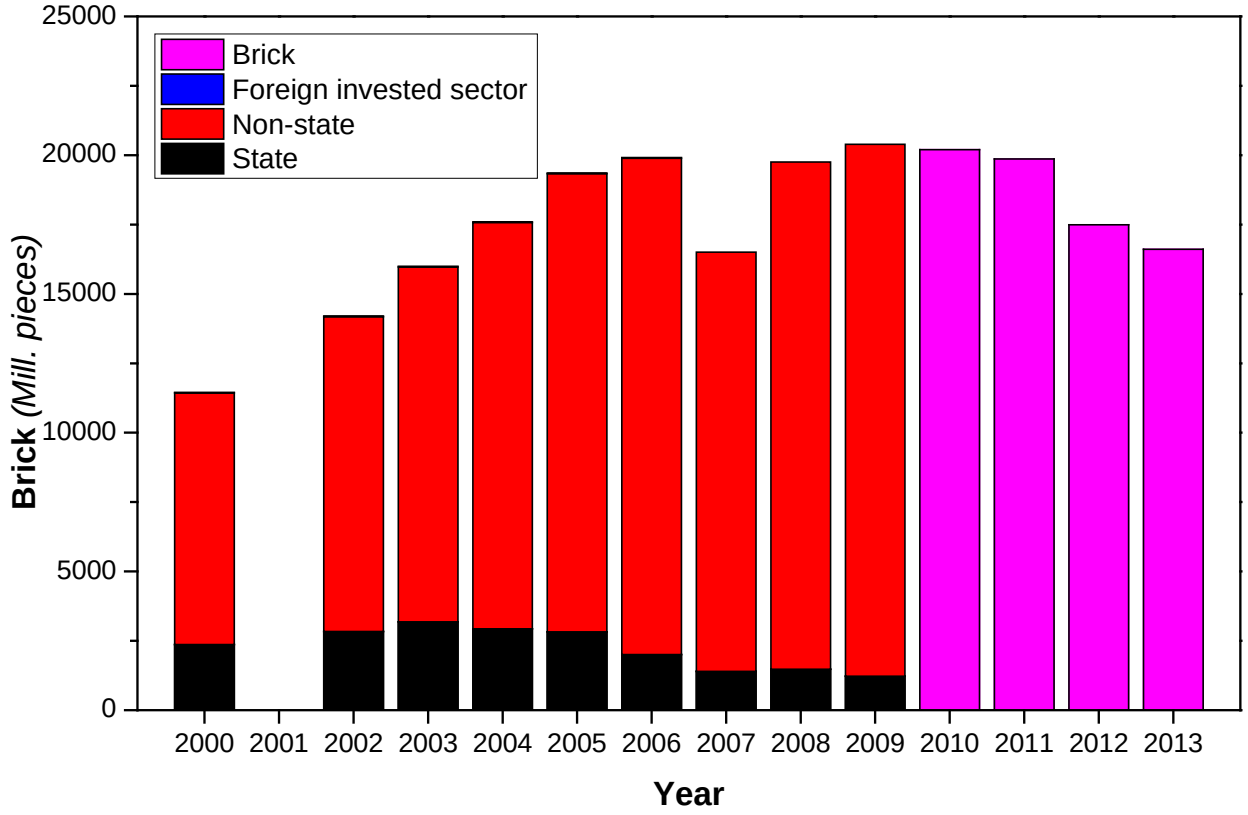
Profile of brick industry in Vietnam

- The brick industry in Vietnam is rapidly developed in four most important economic regions in the northern part of the country.
- Due to the increasing demand of the consumers, especially in urban areas, the development of high quality brick products in Vietnam is faster.
- Bricks are manufactured by manual methods in most provinces in Vietnam.
- Manufacturing technology is simple, apart from the material requirements of suitable soil composition. Many families are able to build a kiln inside their garden, and manufacture bricks for building houses.
- Bricks cannot be manufactured in some locations in the Mekong delta because the clay composition of local soil is not suitable for making bricks.

The brick production of Vietnam

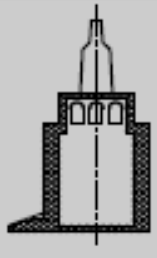
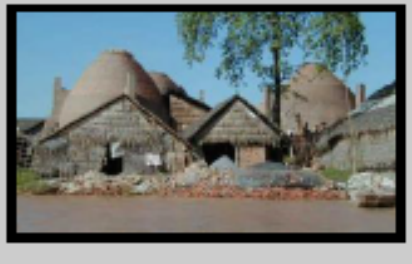
(General Statistics Office of Vietnam, 2000 - 2013)

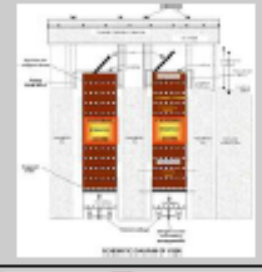
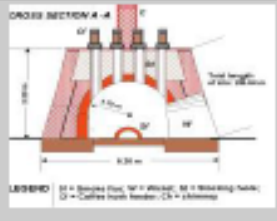
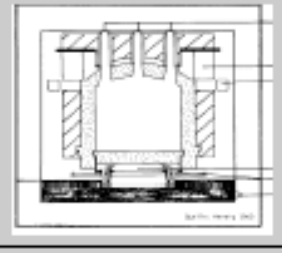
Year	Sector			
	State	Non-State	Foreign invested sector	Total
2000	2363	6706	18	9087
2001	-	-	-	-
2002	2837	8508	20	11365
2003	3187	9597	26	12810
2004	2934	11705	21	14660
2005	2822	13692	16	16530
2006	2007	15875	23	18005
2007	1397	13709		15106
2008	1475	16803		18278
2009	1226	17938		19164
2010				20196
2011				19865
2012				17491



Brick kiln types in Vietnam

1. Traditional brick kiln
2. Traditional - Improved brick kiln
3. Tunnel brick kiln
4. Vertical Shaft Brick Kiln (VSBK)
5. Channel brick kiln

Kiln type	Sketch	Photo
Traditional clamp currently most popular kiln type in Vietnam, batch operation, capacity 30-50 thousand bricks/batch, investment cost negligible		
Traditional kiln with chimney devised & became most popular kiln type in Nam Dinh, batch operation, capacity 50-100 thousand bricks a batch, investment cost 4,000 - 7,000 USD		
Tile kiln horizontal kiln, batch production, capacity 15,000 tiles/batch		
Down draught dome kiln kiln type popular in Southern Vietnam, biomass fired and batch operated, investment costs around 5.000 - 12.000 US$		

Kiln type	Sketch	Photo
Vertical shaft brick kiln (VSBK) optimised kiln type introduced by different projects, original design from China, continuous operation, capacity 2 million bricks/shaft/year, investment cost ~15,000 USD/shaft		
Channel kiln horizontal kiln, single channel, similar to Hoffmann kiln, intermittent operation, capacity 2 million bricks/year, investment cost 30,000 USD		
Tunnel kiln modern technology, highly mechanised, continuous operation, capacity 7-15 million bricks/year, investment cost 300,000-500,000 USD		
Hoffmann kiln continuous kiln type, most popular before introduction of tunnel kiln, capacity 15 million bricks/year, investment cost 150,000 USD		

Tunnel brick kiln

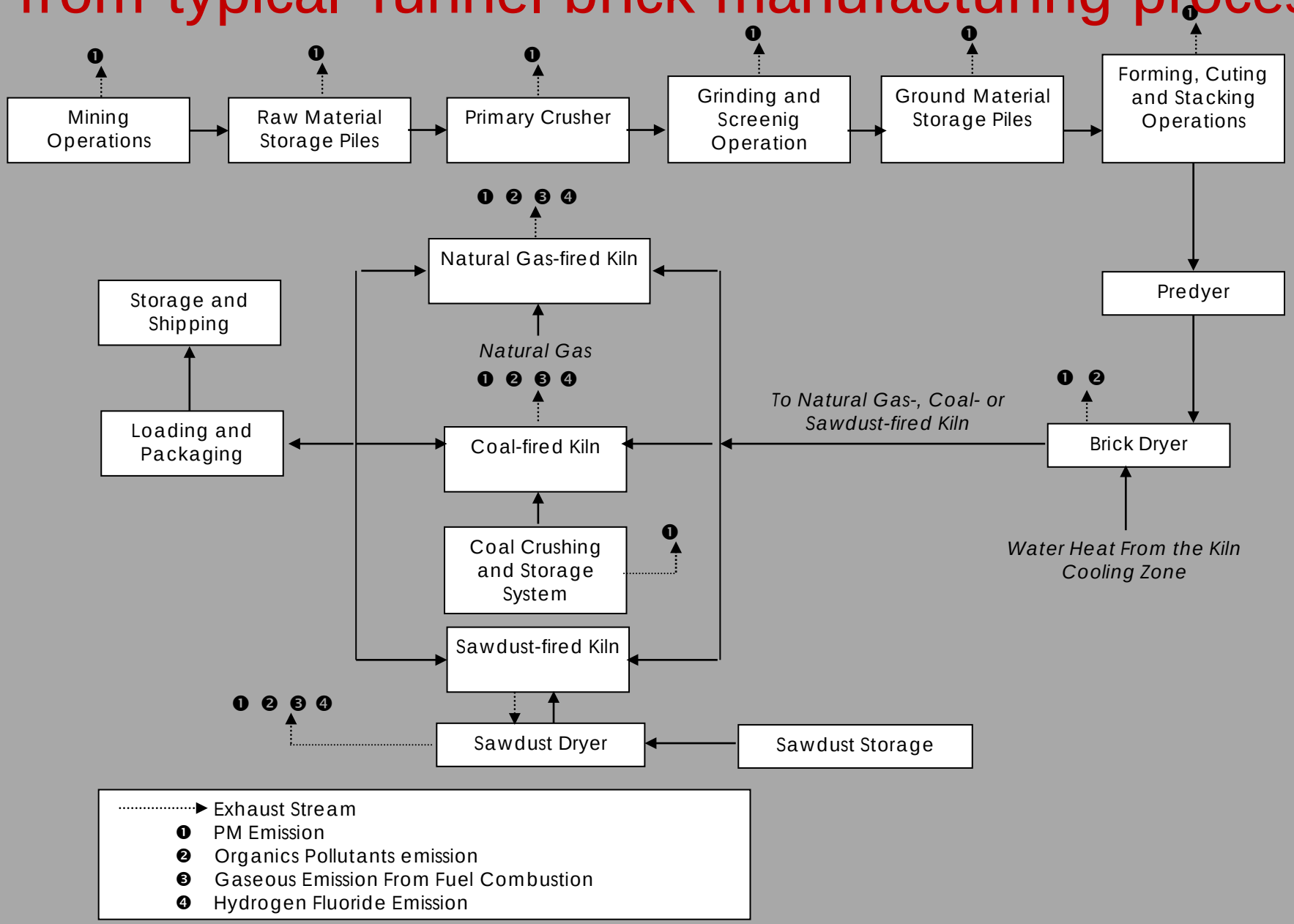
Brick making

2 Case Study with Tunnel kiln in Vietnam

Environmental impacts of brick manufacturing process

- Air Pollutants from brick manufacturing process;
- Impact of emission on ambient air quality;
- Land use / land cover changes;
- Impacts to soil environment;
- Loss of forests and biological diversity.

Air pollution from typical Tunnel brick manufacturing process



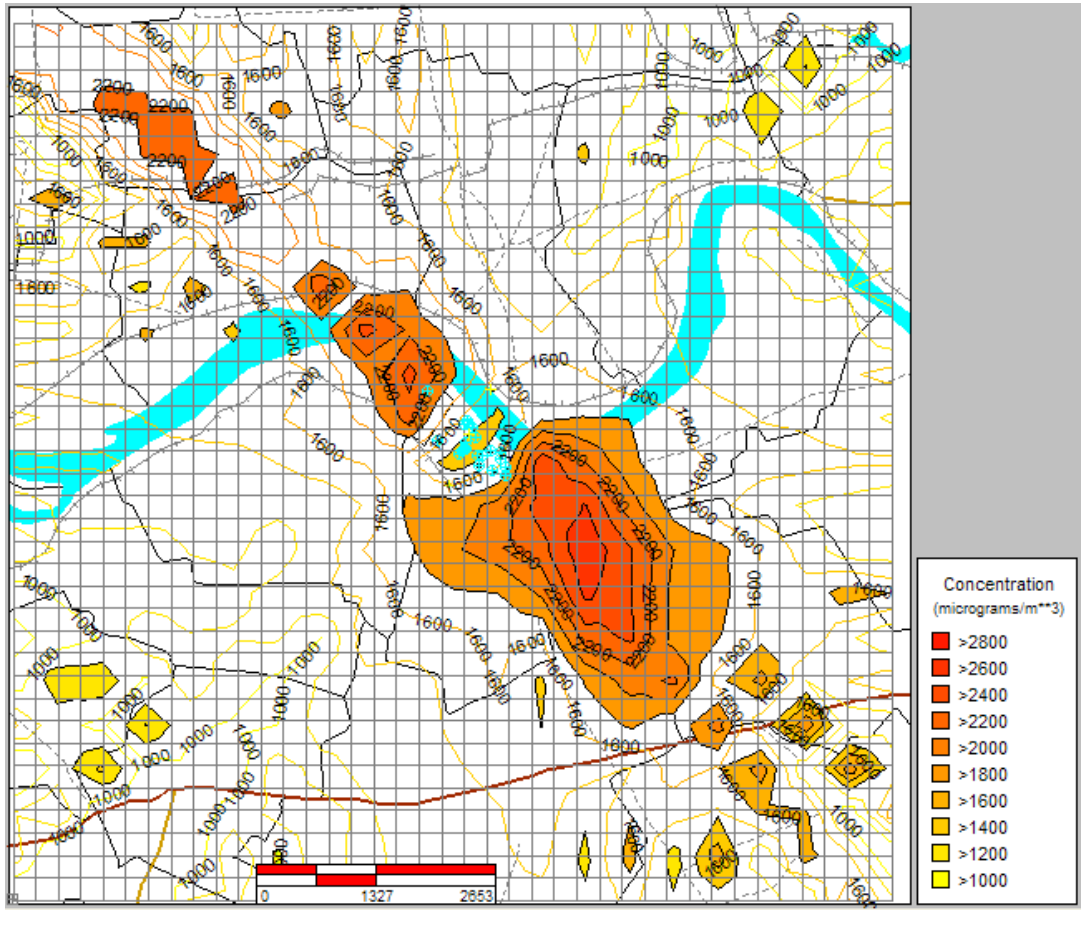
Air Pollutants from brick manufacturing process

Country	Technologies		Specific pollution load (kg/10^3 brick)	
			CO_2	SO_2
China	Intermittent kiln		113	5.0
	Annular kiln	Artificial drying – solid bricks	62	2.7
		Artificial drying – hollow	37	16
		Natural drying – solid bricks	63	2.7
	Tunnel kiln	Artificial drying – solid bricks	80	3.5
		Artificial drying – hollow bricks	48	2.0
India	Clamps	Coal	800	5.2
		Biomass	1,276	1.2
	BTK	Coal	571	3.7
		Biomass	876	0.8
	Hoffman	Coal	685	4.5
		Biomass	1,051	1
	Chamber	Coal	457	3
		Biomass	701	0.7
	Tunnel	Coal	388	2.5
		Biomass	596	0.5
	VSBK	Coal	247	1.8
Sri Lanka	Wood-fired kiln (tile production)		487	0.35
Vietnam	Tunnel kiln (burnt brick)		92	3.1

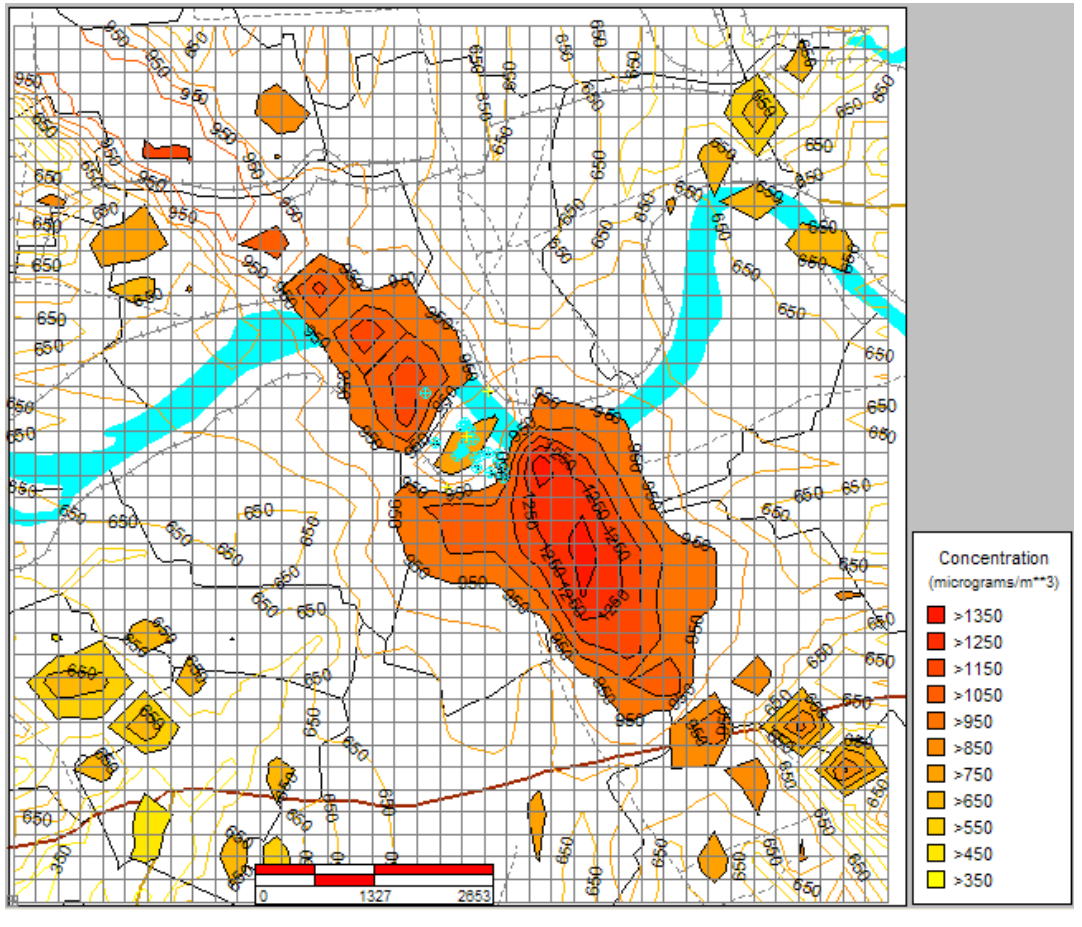
Type of Pollution	Pollutants	Quantity	Unit
Air pollution	CO_2	800	kg/10^3 bricks
	SO_2	1.2	kg/10^3 bricks
	NO_x	0.7	kg/10^3 bricks
	CO	12	kg/10^3 bricks
	CH_4	0.2	kg/10^3 bricks
	N_2O	0.025	kg/10^3 bricks
	Dust (fly ash)	3 - 7	kg/10^3 bricks
Wastewater	Wastewater	5 - 10	l/10^3 bricks
Solid waste	Ash	65 - 85	kg/10^3 bricks
	Substandard brick	350 - 400	kg/10^3 bricks

H.A. Le (AIT Thesis, 2007)
RERIC (Thailand ISBN 974-8209-03-2, 2003)

▪ Air Pollutants from Tunnel brick manufacturing



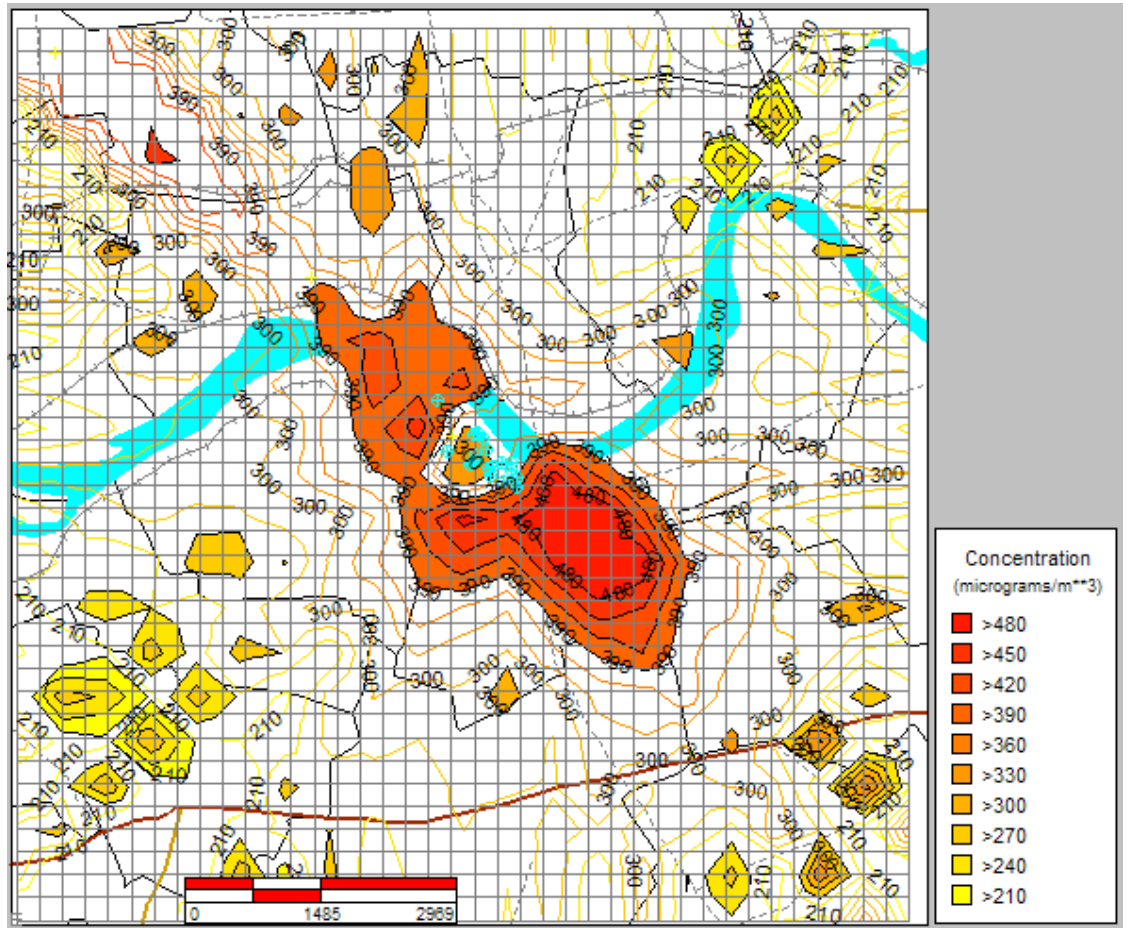
The first highest hour average contour of CO concentration, AAQS of VN (QCVN 05:2013/BTNMT): 30.000 µg/m^3



The first highest hour average contour of SO_2 concentration, AAQS of VN (QCVN 05:2013/BTNMT): 350 µg/m^3

H.A. Le (AIT Thesis, 2007)

The first highest hourly average concentration of SPM is quit with the maximum is about 500µg/m^3. It is noted that most of PM emission from brick kilns are of size of PM_{10}, which is more harmful than large particle. There is no AAQS for 1 hour PM_{10} however, Wark et al (1998) found that it can be made using a factor of 0.4 to obtain 24h average. Thus 24h PM_{10} would be around 200µg/m^3, which is higher than the AAQS of Vietnam of 150µg/m^3.



The first highest hour average contour of SPM concentration, AAQS of VN (QCVN 05:2013/BTNMT): 150 µg/m^3

H.A. Le (AIT Thesis, 2007)

3 Current Policies for Brick Kiln Sector

- The Government of Vietnam issued a decision to ban the traditional brickmaking production within the urban perimeter in the next 5 years (Decision No 15/2000/QD-BXD dated 24 July 2000 of the Ministry of Construction), and it will take full effect in the entire country by 2017.

- Most of the provinces issued regulations to ban the use of agricultural soil, soil of some special land such as historical/heritage sites, soil of dams or irrigating works, and so on.

- Implication of removing all traditional, traditional-improved, and VSBK kilns.

- The Prime Minister issued Directive No. 10/CT-TTg in 2012 aimed to boost use of unbaked building materials and restrict production and use of baked clay bricks.

National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts

(QCVN 05:2013/BTNMT)

$$C_{max} = C \times K_p \times K_v$$

Flow rate (m^3/h)	K_p
$P \leq 20.000$	1
$20.000 < P \leq 100.000$	0,9
$P > 100.000$	0,8

Classification of area and region		Coefficient Kv
Class 1	Interior of special class city [1] and class I city [1]; special-use forest [2]; ranked natural heritage and cultural and historical vestige[3]; industrial manufacturing, processing, trading, servicing premises and other industrial activities less than 2 km far from the boundary of these areas	0,6
Class 2	Interior of city and town at class II, III, IV [1]; suburb of special class and class I city which equal to or above 02 km far from the interior thereof; industrial manufacturing, processing, trading, servicing premises and other industrial activities less than 2 km far from the boundary of these areas	0,8
Class 3	Industrial park, city at class V [1];; suburb of city and town at class II, III, IV which equal to or above 02 km far from the interior thereof; industrial manufacturing, processing, trading, servicing premises and other industrial activities less than 2 km far from the boundary of these areas[4] .	1,0
Class 4	Rural area	1,2
Class 5	Mountainous rural area	1,4

No.	Parameter	Concentration (mg/Nm^3)	
		A	B
1	Total dust	400	200
2	Dust containing silica	50	50
3	Ammonia and ammonium compounds	76	50
4	Antimony and its compounds, calculated by Sb	20	10
5	Arsenic and its compounds, calculated by As	20	10
6	Cadmium and its compounds, calculated by Cd	20	5
7	Lead and its compounds, calculated by Pb	10	5
8	Carbon monoxide, CO	1000	1000
9	Chlorine	32	10
10	Copper and its compounds, calculated by Cu	20	10
11	Zinc and its compounds, calculated by Zn	30	30
12	Hydrogen chloride, HCl	200	50
13	Fluoride, HF, or other inorganic compounds of fluorine, calculated by HF	50	20
14	Hydrogen sulfide, H2S	7,5	7,5
15	Sulfur dioxide, SO2	1500	500
16	Nitrogen oxides, Nox, calculated by NO2	1000	850
17	Nitrogen oxides, NOx (for chemical production facilities), calculated by NO2	2000	1000
18	H_2SO_4 or SO_3 vapor, calculated by SO_3	100	50
19	HNO3 vapor (other source), calculated by NO2	1000	500

Column A: applied until 12/31/2014
Column B: applied from 1/1/2015

National Technical Regulation on Ambient Air Quality

(QCVN 05:2013/BTNMT)

Bảng 1. Giá trị giới hạn các thông số cơ bản trong không khí xung quanh

Đơn vị: Microgam trên mét khối ($\mu g/m^3$)

TT	Thông số	Trung bình 1 giờ	Trung bình 8 giờ	Trung bình 24 giờ	Trung bình năm
1	SO_2	350	-	125	50
2	CO	30.000	10.000	-	-
3	NO_2	200	-	100	40
4	O_3	200	120	-	-
5	Tổng bụi lơ lửng (TSP)	300	-	200	100
6	Bụi PM_{10}	-	-	150	50
7	Bụi $PM_{2,5}$	-	-	50	25
8	Pb	-	-	1,5	0,5
Ghi chú: dấu (-) là không quy định					


Thank you for your attention