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SURVEY ON TOTAL SUSPENDED PARTICULATE PM AND SO_2 CONTENTS IN MAN XA ALUMINUM RECYCLING CRAFT VILLAGE, VAN MON COMMUNE, YEN PHONG DISTRICT, BAC NINH PROVINCE

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Abstract

The study conducted a survey on the dust concentration of PM and SO_2 in the aluminum recycling craft village of Man Xa village, Van Mon commune, Yen Phong district, Bac Ninh province at two sampling locations: the center of Man Xa village and the temple area. The results showed that the dust concentrations of PM from 4 samples were higher than the allowable limit in QCVN 05-2013/BTNMT. Six out of 14 samples with SO_2 exceeded the allowable limit in QCVN 05-2013/BTNMT. The findings of this study are the basis for assessing the spread of air pollution in craft villages.

Keywords: Dispersion of emission from craft village; Emission from craft village.

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1. Introduction

Currently, air pollution has become an urgent problem that needs to be addressed by environmental management agencies. The current situation of socio - economic development of craft villages in recent years has had great impacts on the environment, especially the air environment and has changed the living environment of people towards a worse direction. In Vietnam, air pollution in craft villages is a pressing problem for urban, industrial and craft villages. Air pollution not only adversely affects human health (especially causing respiratory diseases) but also affects ecosystems and causes climate change. The increase in industrialization, the more urbanization development, the more sources of emissions and the greater pressure on poor air quality [1].

Bac Ninh Province with 62 craft villages, including Man Xa aluminum recycling craft village, Van Mon commune, Yen Phong district with a wide variety of products, has created a large number of goods, jobs and income to the people, contributing to promoting the economy of Van Mon in particular and Bac Ninh in general [2]. Man Xa village, Van Mon commune also has common characteristics with other craft villages, such as the development is still without appropriate planning with low technology level and simple labor. In addition, their production is mainly based

on villagers' experience. The awareness of environmental protection of craft villagers is not high. Profit and economic development are put on priority, despite toxicity, danger, environmental pollution and lack of synchronous policies from the central to local management agencies [3].

2. Research subject and methods

2.1. Research subject

The research subjects include: Air quality parameters (PM and SO_2) in the Man Xa aluminum recycling craft village, Van Mon commune, Yen Phong district, Bac Ninh province.

2.2. Sampling locations

- Samples were taken at 2 locations in Man Xa village, Van Mon commune (Table 1).

- Time: From December 5th, 2020 to December 6th, 2020.

Table 1. Sampling locations

No	Sample code	Coordinates		Location	Sampling location description
1	VT01	21°02'28N	105°46'52E	Village center	The place is densely populated with busy traffic. This place generates the most emissions, the environment is typical of a craft village
2	VT02	21°02'09N	105°47'30E	Temple of Man Xa village	A place with a lot of traffic.

Selection of monitoring parameters

- According to Circular No. 24/2017 - BTNMT for assessment of air quality, we chose the following parameters:

+ Meteorological parameters: Temperature, humidity, wind speed, wind direction and pressure.

+ Chemical parameters: SO_2, TSP.

- ***Monitoring time and frequency***

Sampling in the field was carried out in accordance with Circular No. 24/2017 - BTNMT. However, due to time constraints, each location was only sampled for 1 day.

Time: Between 6h00 - 23h00 from October 21st, 2021 to October 22nd, 2020, specifically as follows:

Location 1: From 5h00 on 05/12/2020 to 23h00 on 05/12/2020

Location 2: From 5h00 on 06/12/2020 to 23h00 on 06/12/2020

2.3. Methods

Carrying out sampling in the field, the sampling device was located to avoid direct sunlight for a long time. The device was put on a level surface. Sampling was at inhalation height (above 1 m).

Table 2. Sampling methods

Parameter	Sampling duration (h)	Absorption solution	Volume of absorption solution (ml)	Flow (l/m)	Description
SO_2	2h00	TCM	10 ml/ absorption tube	1.0	Draw into each absorption tube 10 ml of TCM solution, install 2 tubes in series into the AP-02: Set the time to 90 minutes and 30 minutes.

Parameter	Sampling duration (h)	Absorption solution	Volume of absorption solution (ml)	Flow (l/m)	Description
TSP	4h00	filter 47 mm		22 l/m	Use LV-20p, set the filter paper in the correct orientation and sample according to the correct SOP.

Sample preservation and transportation

Table 3. Technical description of sample preservation and transportation

Parameter	Preservation method	Transportation note
SO_2	A sturdy stoppered test tube containing the sample is placed in a labeled rack.	Samples are quickly transported to the laboratory for analysis and the maximum transportation time is 8 hours, if not, the samples should be stored at 5 ^oC for no more than 24 hours.
TSP	Turn off the machine at the end of the sampling period, use tongs to lift the filter paper out of the device and immediately transfer it to the zip bag.	Samples are transported to the laboratory for analysis.

+ Analytical methods in the laboratory:

- Dust analysis according to TCVN 5067:1995 Air quality - Weighing method for determination of dust content.
- Analysis of SO_2 in the air by mercury tetrachloride/para - rosanilin method (TCVN 5971:1995).
- Method of processing and synthesizing research results: The data in this research were processed using Excel software.

3. Results and discussion

3.1. Production process

The main activity of the craft village was aluminum casting. There were 450 households working on aluminum casting (over 100 large - scale production households). In addition, there were 236 households worked on scrap collection.

The metal recycling furnaces used by households all have the same capacity. The amount of fuel used by production households depends on the working time. The current furnaces have a maximum consumption of about 25 kg of coal/hour. From 80 to 100kg of coal were loaded for a time, corresponding to a cooking time of about 10 hours.

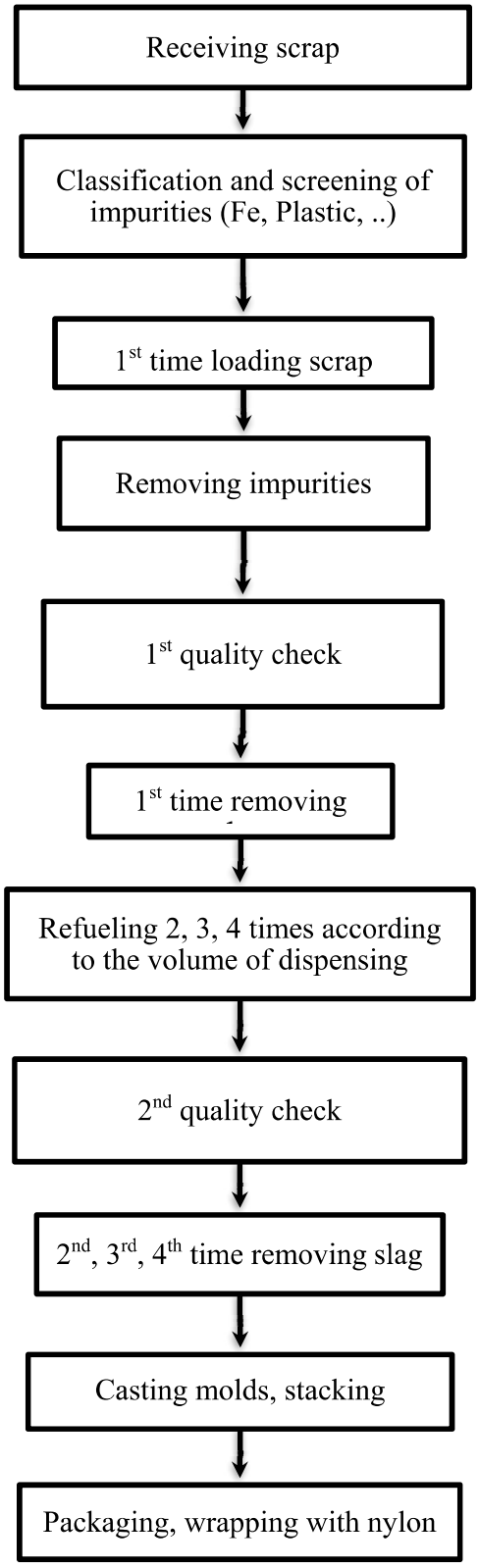

Figure 1: Technological line of aluminum production process in the craft village

3.2. Evolution of microclimate parameters around Man Xa aluminum recycling craft village, Van Mon commune, Yen Phong district, Bac Ninh province

Microclimate parameters were quickly measured using WeatherBug software. The measurement results were shown in Table 4.

Sampling time was in winter, all sampling locations had quite similar weather conditions. The peak temperature was at noon (about 18 ^{o}C) and gradually decreased in the afternoon and evening. At night, the temperature was quite low. Humidity was high in the early morning and gradually decreased by noon and afternoon; with the lowest recorded humidity of 41 % in the afternoon and the highest value of 82 % in the morning. It was sunny on 2 sampling days, with low average humidity. Microclimate conditions were quite favorable for sampling.

Table 4. Average daily results of quick measurement parameters at sampling locations

Nº	Sample code	Wind direction	Temp. (°C)	Humidity (%)	Pressure
1	05.12.SO_2.01-VT01	Northeast	13	61	1024
2	05.12.SO_2.02-VT01	Northeast	14	57	1028
3	05.12.SO_2.03-VT01	Northeast	17	54	1026
4	05.12.SO_2.04-VT01	North Northeast	18	49	1026
5	05.12.SO_2.04-VT01(L)	North Northeast	18	49	1025
6	05.12.SO_2.05-VT01	North Northeast	15	42	1020
7	05.12.SO_2.06-VT01	North Northeast	14	41	1023
8	06.13.SO_2.01-VT02	East	11	82	1023
9	06.12.SO_2.02-VT02	East	16	76	1023
10	06.12.SO_2.02-VT02(L)	North Northeast	16	76	1023
11	06.12.SO_2.03-VT02	North Northeast	20	51	1023
12	06.12.SO_2.04-VT02	Northeast	21	44	1021
13	06.12.SO_2.05-VT02	East Northeast	19	42	1021
14	06.12.SO_2.06-VT02	Northeast	13	41	1017

3.3. Assessment of TSP content in the air at sampling locations

QCVN 05:2013/BTNMT stipulates that the limit value of PM content in the average ambient air for 1 hour is 200 mg/ m^3. The PM content values at monitoring locations were higher than the allowable limit of QCVN 05:2013/BTNMT in 24 hours (Figure 2).

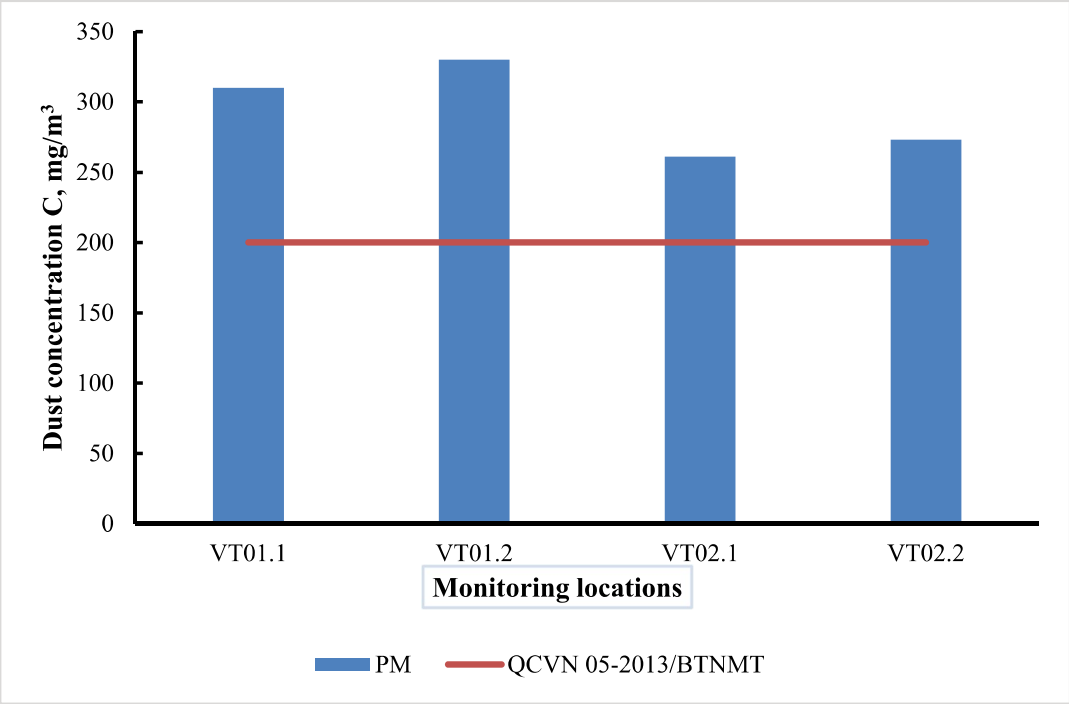

Figure 2: The PM content at monitoring locations

3.4. Assessment of SO_2 content in the air at sampling locations

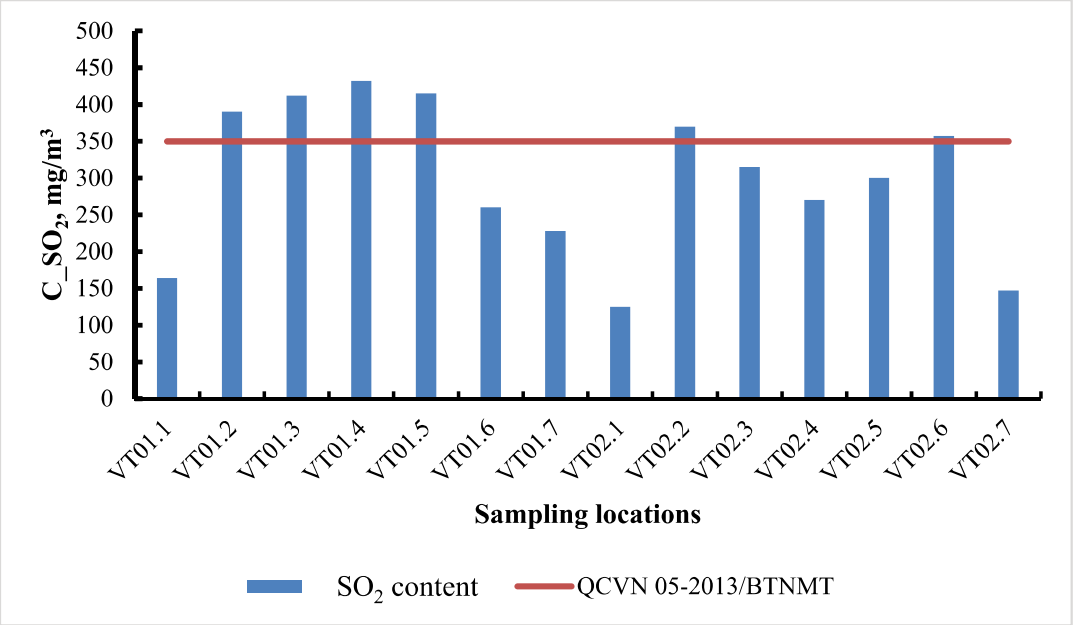

Figure 3: The graph of SO_2 content

QCVN 05:2013/BTNMT stipulates that the limit value of SO_2 content in the ambient air in 1 hour is 350 mg/m3. The results showed that SO_2 concentration at 2 sampling locations at different times of the day exceeded the allowable limit of QCVN 05:2013. At location 01 of the village center, SO_2 concentration was 432 mg/m^3 at 14h00 - 16h00. The influence of microclimate also directly affected the concentration of substances in the air.

3.5. Solutions to reduce air pollution in the craft village

The study offers a number of cleaner production solutions to reduce emissions of craft villages and increase ambient air quality (Table 5).

Table 5. Solutions to reduce air pollution in the craft village

Nº	Solution	Benefit
1	Using coal with low sulfur content and high calorific value	- Reducing the amount of slag - Reducing exhaust gas concentration - Increasing the furnace temperature
2	Equipping workers with dust masks	Minimizing the harmful effects of dust on workers' health
3	Insulating the furnace, avoiding heat loss	- Reducing heat pollution - Saving fuel and energy
4	Maintenance of machinery and equipment	- Reducing noise level - Increasing equipment life
5	Installing a system to collect dust from the furnace	Reducing air pollution
6	Rehabilitating the factory (ventilation, thick wall to prevent noise)	- Reducing noise pollution - Reducing the concentration of exhaust gas in the production area

N°	Solution	Benefit
7	Improving aluminum melting furnace	Increasing performance
8	Installing ventilators to ventilate the factory	Reducing the concentration of toxic gases and dust in the production area
9	Replacing old equipment with new, modern and low-polluting equipment	- Reducing the amount of waste (dust, noise) - Improving product quality

4. Conclusion

SO_2, PM samples were carried out at selected locations in Man Xa village and the content of PM and SO_2 was analyzed. The results showed that the SO_2 content in the air exceeded the allowable limit of QCVN 05: 2013/BTNMT. Meanwhile, the PM concentration at all locations exceeded the allowable limit of QCVN 05: 2013/BTNMT. The findings of this study serve as the basis for assessing the air quality of craft villages.

REFERENCES

[1]. Vietnam Environment Administration, Ministry of Natural Resources and Environment (2016). *Report on the current state of the air environment in 2016*.

[2]. https://bacninh.gov.vn/vi/news/-/details/20182/phat-trien-lang-nghe-tai-bac-ninh

[3]. https://bacninh.gov.vn/news/-/details/20182/lang-nhom-man-xa

[4]. Ministry of Natural Resources and Environment (2017). *Circular No. 24/2017/BTNMT - Technical regulation on environmental monitoring.*

[5]. Ministry of Natural Resources and Environment (2013). *QCVN 05:2013/BTNMT - National technical regulation on ambient air quality.*

[6]. QCVN 5971:1995 (ISO 6767:1990) - Ambient air - Determination of the mass concentration of sulfur dioxide - Tetrachloromercurate (TCM) pararosaniline method.