The Application of Cyclone Ventilator Modification for Indoor Air Sanitation

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The Application of Cyclone Ventilator Modification for Indoor Air Sanitation

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ABSTRACT

There was a need to conduct research on the trial use of cyclone ventilator modification using active carbon as CO adsorbent in an indoor area so that its air fulfills the indoor air sanitation condition. This research was intended to put on cyclone ventilator modification to reduce the temperature, humidity, CO gas level and PM10 dust in indoor area so it can fulfill indoor health sanitation standard. The research used One Group Pretest Posttest Design. Cyclone ventilator modification could reduce indoor mechanic temperature by 10.919% in average, air humidity in average by 28.64%. The ability to reduce CO gas level was 28.65% in average and PM10 dust for about 52.80% after 2 hours the instrument works. Cyclone ventilator modification takes 2 hours to reduce temperature, humidity, CO gas level, and PM10 dust accumulated for 4 hours inside of mechanical room. Cyclone ventilator modification worked effectively operated inside of the room with 115.6m 3 volume and was able to create a quality standard circumstances. The performance of Cyclone Ventilator Modification as an air sanitation instrument can be evaluated from energy and economical aspect in general. Secondly, those aspects shows that indoor air sanitation instrument can only works (moves) using the wind breeze.

Keywords: *Implementation, Cyclon, Modification, Indoor, Temperature, Humidity, CO, PM100 dust.*

INTRODUCTION

The reduction of CO gas level after going through indoor air sanitation instrument with the suction using charcoal/active carbon of coconut shell as big as 185.3 ppm with 73.9% reduction. There is also significant different reduction of carbon monoxide[(1)]. The reduction precentage of CO gas level by using active carbon of coconut shell is 81.54%. The effectiveness evaluation of air sanitation stated to be effective because it can reduce CO gas level more than 75%[(2)]. Life time active carbon as CO adsorbent as long as 388 hours. This instrument is very effective because it can reduce CO gas level more than 60% in 352 hours. While, the efficiency of this instrument can be showed by the effectiveness of this instrument in reducing CO and its relatively small cost aspect because it doesn't use electricity energy to operate it[(2)].

Based on the above explanation, there is a need to conduct further research for the trial use of cyclone ventilator modification by using active carbon as CO adsorbent in an indoor area so that its air fulfills the indoor air sanitation condition based on the Decree of Minister of Health No. 1405/MENKES/SK/XI/2002 concerning Health Requirements for Office and Industrial Work Environment [(3)].

MATERIALS AND METHOD

The design of this research was One Group Pretest Posttest. Materials used was coconut shell active carbon by the size of 125 um (got from sieve of 120), glue glass (sealent Seal), reagent gas absorption (CO) to collect CO sample, reagent to examine CO gas, plastic interval (diameter 0.3 cm), glass bottle, and aluminium gauze. Research instruments used in this research were Cyclone Ventilator Modification, Migget Impinger, Flow Meter, Stopwatch, Handscoon, and mask.

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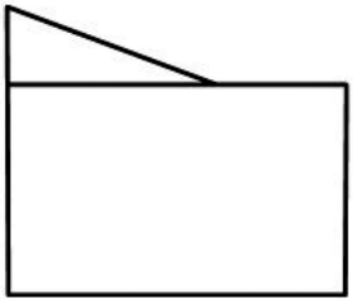
Sample to meassure CO gas level was determined based on purposive sampling. Sample was taken by doing measurement as much as 10 times, to detect the average CO gas level, PM10 dust, temperature and indoor wind velocity before and after the treatment (installing cyclone ventilator modification). Data analysis process used paired sample t-test

FINDINGS AND DISCUSSION

The Room Volume of Research Spot: The volume of Mechanical Research Spot was measured by calculating room volume added by roof volume. Here was the detail calculation:



Structure Volume:

Room Volume + Roof Volume

$= (p \times l \times t) + (½ \times a \times t \times p)$

$= (4 \times 6.5 \times 4)\ m + (1/2 \times 4 \times 1.45 \times 4)\ m$

$= 104\ m^3 + 11.6\ m^3$

$= 115.6\ m^3$

Figure 1: Research Spot Volume Scetch

Air temperature, air speed, humidity, CO gas degree, and PM10 dust measured before and after cyclone ventilator modification was installed and operated, so that there was air temperature comparison inside of the room before and after cyclone ventilator modification was settled and operated. Data collection was done in two hour duration before the operation of cyclone ventilator modification operated (09.00 and 11.00 WIB) and in two hours after the operation of cyclone ventilator modification operated (13.00 and 15.00 WIB), in one day for 10 days.

The Ability of Cyclone Ventilator Modification to Reduce Temperature, Humidity, CO Gas and PM 10 Dust Inside of Mechanical Room: The ability of cyclone ventilator modification to reduce temperature inside of mechanical room in average was 10.919% in every 2 hours operation, its ability to reduce air humidity in average was 28.64% in every 2 hours operation, and the ability to reduce PM10 dust in average was 52.80 % in every 2 hours operation. It concurs the previous research about the effectiveness of cyclone ventilator modification instrument to reduce CO gas and PM 10 dust level[2]. Air flow speed inside of the tmechanical room increases was 48.71% in every 2 hours operation.

The use of active carbon in cyclone ventilator modification was effective to absorb CO gas as same as Nurullita & Mifbakhuddin in their research about Monoxide Carbon Gas Absorption (CO) inside the coconut shell active carbon and durian shell explains that the presentage of CO gas reduction by using coconut shell adsorbent is 62.6%, while durian shell is 70.6%[4]. This concurs and strengthens the previous research[2] that life time carbon is active as adsrobent CO as long as 388 hours, while the life time (saturated point) for filtering the dust has not been achieved. This instrument is very effective because it can reduce CO gas more than 60 % for 352 hours. Whereas, the efficiency of the instrument is shown from the effectiveness reduce CO gas and dust and the low non electricity operating cost. The most used adsorbent is active carbon becuase it has big surface. So, it absorbs bigger energy than another adsorbent. The application of adsorption energy is mostly used in industry. The example of adsorption application vapour phase is the restoration of organic solvent used by substance, printing ink and textile coating. While the adsorption of liquid phase used to seperate organic components from liquid and water waste from the substance of organic liquidd[5].

Jaya et al. stated that emission gas NO and Nox that are adsorbted was 70%. That proves the effectiveness of active carbon used to reduce air pollutant[6].

The Ministry of Health Decree No. 1405/MENKES/SK/XI/2002 requires that the room temperature has to be 18°C-26°C, the humidity is 40%-60%. Maximum dust content inside the room in average 8 hours meassurement is 0.15 mg/m^3. Ventilation air flows is 0.15-0.25 m/s and CO gas pollutant is 25 ppm/8 hours. This research has answered that the existance of cyclone ventilator modification in mechanical room has created and proven that it can be used to fulfill the requirement as air controller instrument inside the room, so that the mechanical room fulfill the requirement/quality standards.

The paired sample t-test in temperatue, humidity, CO gas level and PM 10 dust parameter, inside the room

resulted p-value of 0.000 (there was significant difference between of parameter before and after installing and applying cyclone ventilator modification).

While the air flow speed inside the room increases fluctuatively as shown in Figure 2.

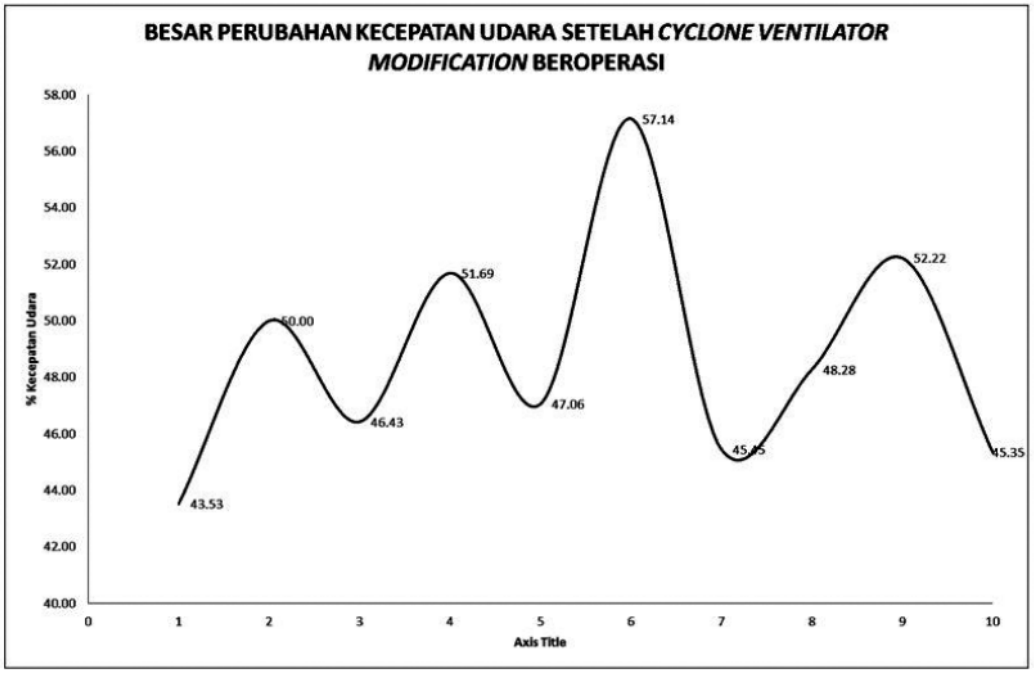


Figure 2: The Increase of Indoor Air Flow Speed After Installing/Operating Cyclone Ventilator Modification

The problem of Cyclone Ventilator Modification application is there should be preliminary test if the instrument will be installed in another place which has higher pollutant variation with the width and volume that is as same as 115.6 m^3

Time needed for cyclone ventilator modiication to reduce temperature, humidity, CO gas degree and PM10 dust until optimum limit of certain room: The meaning of optimum limit is fulfill quality standard of working area based on The Ministry of Health Decree No.1405/MENKES/SK/XI/2002[3] that is 18^{0}C-26^{0}C for room temperature, 40%-60% for humidity. Maximum dust content inside of air temperature in average measurement in 8 hours is 0.15 mg/m^3. Ventilation air flows is 0.15-0.25 m/s and CO gas pollution is 25 ppm/8 hours.

Time needed by cyclone ventilator modification to reduce temperature, humidity, CO gas degree and PM10 dust in this research was 2 hours. This is as same as the result of parameter massurement in first length of time, that is 2 hours after being installed and applied. It has accomplished qualification standard of working environment. However, in this research the specific time, in which minute in particular, the parameter reduction will reach the standard cannot be determined. It is because the measurement is done in the 2 hours length of time. It is not a continous measurement which can get more specific data of time. Cyclone ventilator modifivation can reduce indoor mechanical temperature in average by 0.919% and reduce air humidity in average of 28.64%. While the ability to reduce CO gas level in the average of 28.65% and decrease PM10 dust in average of 52.80% after 2 hours the instruments operates.

In this research, after the instruments operates for 10 days, the ability to reduce CO gas level was 4.55% in the first day and becomes 62.88% in the tenth day. While, for the PM10 dust was 24% in the first day and becomes 82.68% in the tenth day. The longer the instrument operates, its ability to reduce CO gas and PM 10 dust will increase. Whereas, the temperature parameter and humidity creates fluctuative result.

The Effectiveness of cycolne ventilator modification towards the room area/volume: The use/instalation of 1 unit cyclone ventilator modification in a room with the volume of 115.6m^3 becomes effective by looking at

the ability in reducing temperature, humidity, CO gas and PM10 dust level until fulfill the quality standards of workimg room in 2 hours operational of cyclone ventilator modification, it can also maintain the condition of the working condition in further hours. It is because there is an active carbon as cyclone ventilator modification which has a life time of l388 working hours[2].

The implementation of 1 unit cyclone ventilator modification in 115.6 m^3 room volume can be recommended and proven effectively to be applied in industry which has working area potentially producing CO gas and PM10 dust level.

In this research, cyclone was operated after having pollutant parameter accumulation with 2 hours mesassurement in 115.6m^3 room volume which has accomplished quality standards. If it is assumed, cyclone ventilator modification operational simulation done in the same time with operational machine in mechanical room. It can be sured that the condition of the working room with that width will not exceed the determined limit (further research).

The excess of active carbon in the cyclone ventilator modification is strengthen by the research of Raso et al. They stated that we demonstrate two steps process where air sanitation system based on active carbon can be regenerated by "in situ" and eliminate volatil organic compound (VOC) from indoor air by using energy efficiently[7].

Performance of Cycolne Ventilator Modification: Performance of cycolne ventilator modification as an indoor air sanitation in general can be evaluated by its energy and economical aspect. Those two aspects show that indoor air sanitation operates (moves) by wind breeze and because of the different air pressure inside and outside of the room. Naturally, higher temperature air inside the room will scientifically flow/move to the lower air temperature outside the room through cyclone ventilator modification fin, so the additional energy is not needed to operate the instrument. This is efficient in the instrument operation.

The suction power of cycolne ventilator modification depends on air speed that hits instrument fin. Cyclone ventilator modification can handle hot temperature problem, stuffy and dirtyn in the room, reducing humidity and freshen working room (normal air circulation). Cyclone ventilator modification is anti-rust product which is suitable for tropical climate, durable and flexible, doesn't need special treatment, efficient, and very quick and easy in the installation process.

CONCLUSION

1. Cyclone ventilator modification could reduce indoor mechanical temperature in average of 10.919%, air humidity in average of 28.64%, CO gas level in average was 28.65% and PM10 dust in average of 52.80% after 2 hours of operation.
2. Cyclone ventilator modification in 2 hours of operation could reduce temperature, humidity, CO gas and PM10 dust level that were accumulated in 4 hours inside the mechanical room.
3. Cyclone ventilator modification was effectively operated in a room with the volume of 115.6 m 3 and was able to produce the condition that meets the quality standards.
4. The performance of cyclone ventilator modification as air sanitation instrument was proven to be able to solve hot temperature, stuffy and dirty problem in the room, reducing humidity, to make the working space more comfortable, anti-rust product which was suitable for tropical climate, durable and flexible, doesn't need special treatment, efficient, and is very easy and fast in the instalation process.

RECOMMENDATION

1. The application of cyclone ventilator modification can be done by considering the instrument ability, room volume, and pollutant level in that room to get optimum formulation to fulfill quality standards inside the room.
2. The research of the application of cyclone ventilator modification can be a reference for another researcher to develop further step, such as the application of cyclone ventilator modification to other parameter in this research.

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Ethical Clearance: Yes

Conflict of Interest: No

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