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Decreased Levels of Carbon Monoxide through Recovery Tools on Sanitation Indoor Air

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Abstract
Carbon monoxide (CO), which is one of the biggest indication of air pollution due to the proceeds of incomplete combustion from vehicles, industry and households. The aims to 1) determine the levels of CO gas before and after by means of restructuring of air chambers, 2) analyzing the gas content of CO after by means of restructuring of air to reduce levels of CO gas, and 3) determine the value of the effectiveness and efficiency of the appliance recovery room air to lower levels of CO gas that has been made. This research is a form of pre experiment with one group pre-post test design. The data analysis used paired t test. The results showed average levels of CO gas before recovery room air through the tool of 293.04 ppm and afterwards amounted to 54.12 ppm. The percentage decrease in the levels of CO gas is an average of 81.54%. The results of the analysis paired t test showed p = 0.000 <α (0.05), which indicates that there are differences between the levels decrease significantly before and after CO gas by means of air recovery room. Evaluation of the effectiveness of the air was declared effective recovery tool is able to reduce the CO gas is more than 75%. Efficiency can be demonstrated by the effectiveness of the tool in reducing CO gas and a relatively long lifespan and the costs can be reduced because the tool does not use electrical energy.
Keywords: CO, effectiveness and efficiency, indoor air sanitation

1. Introduction

Increased CO in the atmosphere is significantly influenced by the result of the rapid development of industrial technology through the greenhouse effect. The greenhouse effect of these gases cause environmental pollution, worsen global warming, increasing sea levels, and affect the balance of the ecosystem. Among the greenhouse gases, the greenhouse effect of CO has the greatest impact on global warming (Figueroa et al., 2008; Yang et al., 2008). A data released by the Global Burden of Disease Study in Saragih (2011) that was published in a british medical journal called Lancet that seven million people die from air pollution in 2010. The study also found that indoor air pollution has killed 3 5 million people worldwide in 2010, while outdoor air pollution has killed 3.3 million people. So keep in mind that air pollution is the presence of one or more physical substance, chemical, or biological weapons in the atmosphere in quantities endangering human health of animals and plants, mengggganggu aesthetics and comfort, or destruction of property (EPA in Nurbiantara, 2009).

Problems in the indoor air pollution is the main pollutant concentrations are found more in the house (indoor) than outdoors (Minnesota Department of Health in Saragih, 2011). Saragih (2011), the presence of pollutants in indoor air can cause disruption in good health in the long term or short term with a source of air pollution can come from household activities from the kitchen, smoke, building materials and others. Guritno (2012), states that indoor air pollutants are found from the smoke of burning gas containing carbon dioxide as a result of incomplete combustion. Therefore, the government made a rule related to the presence of CO in indoor air contained in Permenkes No.1077 of 2011 on Guidelines for Indoor Air Sanitation House with the required maximum concentration of 9.00 ppm/8 hours. The need to tackle the CO gas that are in this room is needed in order to bring healthy air and away from indoor air pollution.

The handling of air pollution originating from the CO gas is necessary to realize, especially air pollution occur in the room where the level of danger is greater than the outdoors. With lower levels of CO gas is in the room is an effort that CO gas levels remain below the applicable standards and are not harmful to human health. Based on the above, it is necessary to do deep research about the decreased levels of CO gas through recovery tools on sanitation indoor air.

2. Literature Review

2.1. Air

Air is a natural resource which must be protected for life, human life and other living creatures (Depkes, 2002). Air is the most important substance after water in the giving of life on the earth's surface and also serve as a conductor of sounds and noises, cooling hot objects, and can be a medium for the spread of disease in humans. The air is said to be "Normal" and can support human life. While in case of the addition of other gases that cause interference and changes in the composition, then the air is said to have been contaminated/polluted (Kastiyowati, 2011).

2.2. Indoor air pollution

Indoor air quality is a problem that needs attention because it will affect human health. According to Hunter (2004), indoor air pollution becomes more serious health problem than outdoor air pollution, because on average we spend 75% of time to be in the room. According to the EPA and mud (1990) in Fitria et al. (2008), the main problems are often obtained from a variety of research on indoor air quality include three general categories that are sorted by frequency of occurrence, which is the highest is not strong ventilation, chemical contamination, and the lowest is microbiological contamination. Maryanto et al. (2009), based on the effects of air pollution on health disorders can be divided into three types: irintasi, asfixia, and anesthesia.

2.3. Carbon Monoxide

Carbon monoxide is a gas that is colorless, odorless and tasteless. CO gas can be a liquid at a temperature of -1920C (Wardhana, 2001). Furthermore, according to Mark Goldstein (2008) in Agusta (2012), carbon monoxide is known as a pollutant that is harmful to humans so that its content in the air is very necessary to be reduced. Reaction formation CO quicker than the reaction of the formation of CO, so that the end result is still possible there is a gas combustion CO (Wardhana, 2001).

2.4. Air sanitation

Clean air is a gas that is invisible, odorless, colorless and tasteless. But the air is really clean has been difficult to obtain, is because many natural activities and human activities that can damage the environment and human life. Means less environmental damage (damage) natural carrying capacity which in turn reduces the quality of human life (Wardhana, 2001).

Therefore it is very necessary efforts to restructure the air, where the air is a definition of restructuring carried out in order to restructure the air around us as living beings are not experiencing contamination that can impact on health. Restructuring includes monitoring air until an analysis of the quality and state of the air. Restructuring the air is not only limited to the gases in the air, but including humidity, temperature, etc. (Depkes, 2002)

3. Methodology

The study was conducted in PT Kalimaya Surabaya and Laboratory of Health Ministry health Polytechnic Surabaya (Laboratory of Environmental Health and Integrated Laboratory) in January-December 2015. Materials research: coconut shell activated carbon grain size of 125 um (obtained from a sieve mesh size of 120), sealent seal, reagent gas absorpsion (CO) for sampling gas CO, reagent for inspection of CO gas, plastic tube (diameter 0.3 cm), glass bottle, and kasa aluminum. Equipment research; recovery tools on sanitation indoor air (cyclone/turbine ventilator and activated carbon reactor), migget impinger, flow meter, stopwatch, handscoon, and mask. The research sample that CO gas that comes from the burning cigarette smoke. The samples for the measurement of CO gas levels by purposive sampling. This study is experiment research using one group pre-test post-test design and data analysis using the paired t test.

4. Result and Discussion

4.1. Gas content analysis CO

The results of the analysis of the gas content of CO after a recovery tool to air the room in terms of ratio of CO gas levels before and after through room air recovery tool shown in Table 1.

Table 1. Measurement of CO gas levels before and after through room air recovery tool

No. Test	The results of the levels of CO gas		Difference decrease (ppm)
	Pre-test (ppm)	Post-test (ppm)	
1.	291	39	252
2.	295	40	255
3.	298	37	261
4.	302	45	257
5.	281	38	243
6.	294	42	252
7.	299	43	256
8.	303	49	254
9.	281	33	248
10.	296	37	259
11	301	41	260
12	289	36	253
13	297	56	241
14	284	52	232
15	293	63	230
16	297	59	238
17	288	60	228
18	291	64	227
19	270	59	211
20	294	68	226
21	302	81	221
22	294	80	214
23	297	90	207
24	296	87	209
Average	293,04	54,12	238,92

Table 1 shows that the decreased levels of CO gas on average 238.92 ppm after passing gas recovery tool inserted room activated carbon. Decreased levels of CO gas after through room air recovery tool can be the result of an adsorpi process in reactors containing activated carbon. The adsorption process is a process in which a particle attaches to a surface due to the difference in charge between the two objects is weak, so that eventually will form a thin layer of fine particles on the surface (Reynolds, 1982 in Basuki et al., 2008). The adsorption process can occur by activated carbon because of their pores in activated carbon are capable mengadsorpi CO gas. A porous carbon-based material has a thermal stability and high chemical and good adsorption capability (Figueroa et al., 2008; Huang et al., 2014; Belhalchemi et al., 2014; Huang and Wen, 2014).

Meilita (2003) in Dunggio (2012) explains that the activated carbon material is in the form of free carbon or charcoal that has been created and processed exclusively through the activation process, so that the pores open and thus has great absorption of the gas phase. The use of this carbon has the advantage that, as the prevention of pollution, low cost and can be recycled (Foo & Hameed, 2009; Nowicki et al., 2010; Chen et al., 2013). In normal circumstances the interlayer space on activated carbon (coconut shell) filled by free water molecules located around cations. When the coconut shell charcoal is heated to a temperature of 100°C, the water molecules will evaporate (out) so that akit carbon (coconut shell charcoal) can function as a gas absorber. But if the coconut shell charcoal is heated to temperatures above 150°C, the structure of coconut shell charcoal will be broken because it does not heat resistant (Basuki et al., 2008). Coconut shell charcoal is the raw material that has the potential for the production of activated carbon, because it has an excellent natural structure and low ash content. Conversion coconut shells into activated carbon which is better (Huang et al., 2015) and can be used as adsorbent cost to absorb heavy metals in the solution of industrial wastewater (Song et al., 2013; Rajput et al., 2015), helps reducing waste disposal costs and provide alternatives that have the potential cost of carbon commercial (Bansode et al., 2003; González et al., 2006; Ioannidou and Zabaniotou, 2007; Li et al., 2008; Chengwen et al., 2014; Etim et al., 2015). The results of the percentage reduction in the levels of CO gas by activated carbon to the air recovery tool room that had been treated (heating) are shown in Figure 1.

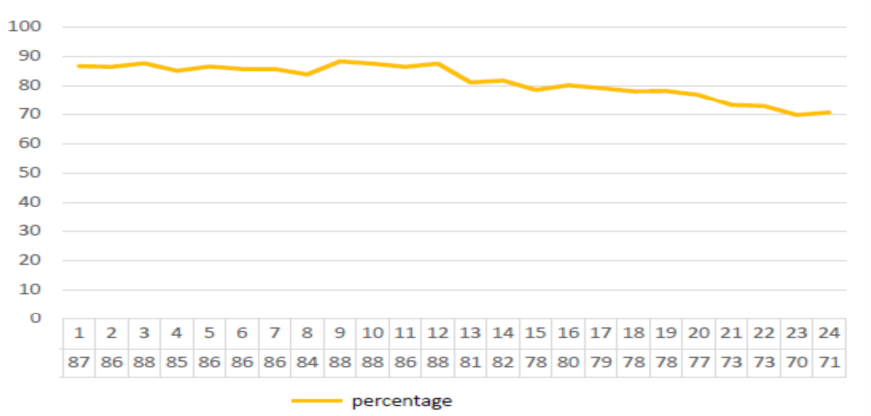

Figure 1. Percentage decrease in the levels of CO gas in room air recovery tool

Figure 1 shows the percentage reduction in the levels of CO gas in room air recovery tool experiencing declining graph from test to test for a 1 to 8, which is then increased back to the test to 9. The movement of the fall looks back up at test 13 to the test to 24. the percentage decrease in the levels of CO gas in air sanitation tool room is the highest percentage in the test to 12 with 88.26%, while the lowest percentage drop is the test to 23 to 69.7%. Figure 1 also shows that the value of the measured levels of CO gas is not stable, increasing and lowering the test 1 to test 24. This can occur because of differences in the ability of granular activated carbon to adsorb CO gas that react to each reactor in the tool. Contaminants gas that has passed through the adsorption section has a concentration of zero, but because of factors equilibrium and kinetic factors, some gas with low concentrations of contaminants will escape in the effluent (Basuki et al., 2008). Paired t test results obtained $p = 0.000 < \alpha$ (0.05), which indicates that there are differences between the levels decrease significantly before and after CO gas by means of air recovery room.

4.2. Evaluation of recovery tools indoor air the ability to reduce levels of CO

Ability vacuum efficiency air used for room air recovery tool can be viewed in terms of the energy source to turn on the device, the device can work when the pressure and the heat coming from inside the room sank out of the room that drives the tool to have dayaberputar. In addition, the air stream being outdoors also helps push the device to spin. Cyclone works by forcing the suspension of gas flowing spirals in a closed space, so that the particles exhaled towards the vessel wall centrifuges. Particles moving downwards by gravity and is removed from the cyclone container, and the gas which has been filtered spun out upwards (De Nevers, 2010). As for the ability of vacuum suction airflow by air amounted to 8.49 m/s. With disuse of AC and DC power source that can play a cyclone, then use the difference in pressure and temperature inside and outside the room can be said to save costs used in welding operations.

The room air recovery tool has an average of 81.54% effectiveness in lowering levels of CO gas. According Maryanto et al. (2009), adsorption on activated charcoal occurs physically, adsorption occurs because the properties owned activated charcoal as an absorbent, molecular sieves, catalysts and ion exchangers. Activated charcoal is an adsorbent which has pores very small diameter which can absorb the gas, so gas CO who pass by it will be bound and experience the attractive forces with pores of activated charcoal. So there is a long enough contact time for this reaction occurs. In this process will affect the capacity of the adsorbent. Adsorbent capacity will be saturated with increasing time since had many adsorbat attached to the adsorbent (Basuki et al., 2008). According to the theory of adsorption, adsorbate particles will approach the pores. Supposedly Langmuir during contact occurs between the adsorbate and adsorbent particles will occur two-way process is the adsorption and desorption. At the time of equilibrium, the adsorption rate equal to the rate of desorption so that the concentration of the adsorbate in the solvent remains.

The time required from start comes in contact with the adsorbent adsorbate equilibrium to occur is called the equilibrium time. At the time of equilibrium, it is considered that all the parts on the surface of the adsorbent has been filled by particles of adsorbate (Sukir, 2008). So that when the time equilibrium occurs, the CO gas (adsorbate) will only pass through the reactor without experiencing a reaction. So that the contact time will be faster.

5. Conclusion

CO gas levels before and after through the recovery tool room air differs significantly according to the statistical test paired t-test is p = 0.000. The results of the evaluation of the effectiveness of sanitation tool room air to reduce levels of CO gas that has been made can be said to be very effective because it can reduce levels of CO gas is an average of 81.54% (≥ 75%). Evaluation of the efficiency of the room air recovery tool to reduce

levels of CO gas that has been made can be said for including the effective and efficient use of the air without using electricity restructuring.

Implementation of this research that this room air recovery tool can be used for the general public, industry and others in dealing with pollution of carbon dioxide and gases - other gases. Given the restructuring of air tools with coconut shell activated carbon adsorbent is effective and efficient in reducing pollutant gases CO.

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