C-12

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : PROSIDING

Judul karya ilmiah (paper) : Analysis of benzene exposure considering workers characteristic in the oil and gas industry
Jumlah Penulis : 3 orang (Yusita Attaqwa, Manik Mahachandra**, Heru Prastawa**)
Status Pengus : Penulis ke-3
Identitas Makalah : a. Judul Prosiding : International Conference on Advanced Mechanical and Industrial Engineering (ICAMIE 2020)
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c. Tahun Terbit, Tempat Pelaksanaan : 8-9 Juli 2020
d. Penerbit/organiser : IOP Conferences Series : MSE
e. Alamat repository PT/web prosiding: https://aip.scitation.org/journal/apc
PROSIDING : https://iopscience.iop.org/issue/1757-899X/1072/1
ARTIKEL : https:// doi:10.1088/1757-899X/909/1/012059
f. Terindeks di (jika ada) : SCOPUS, J.Global,
g. Turnitin Similarity : 12 %

Kategori Publikasi Makalah : ☐ √ *Prosiding* Forum Ilmiah Internasional
(beri ✓pada kategori yang tepat) ☐ *Prosiding* Forum Ilmiah Nasional

Hasil Penilaian *Peer Review* :

Komponen Yang Dinilai	Nilai Maksimal Prosiding		Nilai Akhir Yang Diperoleh
	Internasional 30	Nasional ☐	
a. Kelengkapan unsur isi prosiding (10%)	3		2,5
b. Ruang lingkup dan kedalaman pembahasan (30%)	9		8
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	9		8
d. Kelengkapan unsur dan kualitas terbitan/prosiding(30%)	9		8
Total = (100%)	30		26,5
Nilai Pengusul = (40/2)%) * 26,5 =5,3			

Catatan Penilaian Paper oleh Reviewer :

1. **Kesesuaian dan kelengkapan unsur isi paper**: Penulisan paper sesuai dengan Author Guidelines (Title, Abstract, Introduction, Materials and Methods, Results and Discussion, Conclusion, Acknowledgement, References). Substansi artikel sesuai bidang ilmu pengusul/penulis pertama (Teknik Industri). Terdapat benang merah dalam struktur penulisannya.
2. **Ruang lingkup dan kedalaman pembahasan**: Substansi paper sesuait dengan ruang lingkup Seminar (International Conference on Advance Mechanical and Industrial Engineering). Paper ini membahas tentang pengaruh paparan benzene terhadap pekerja di perusahaan minyak dan gas, khususnya TPBM Semarang Group. Pembahasan dilakukan secara mendalam (20 dari 45 buah rujukannya dilibatkan dalam proses pembahasan).
3. **Kecukupan dan kemutakhiran data/informasi dan metodologi**: Data-data hasil penelitian menunjukkan adanya kebaruan informasi. Kebaruan penelitian ini desain produk mempengaruhi dampak produk terhadap lingkungan, di mana desain modular memiliki dampak yang lebih kecil. Sebagian besar rujukan menunjukkan kemutakhiran (16 rujukan berusia kurang dari 10 tahun). Dari 45 rujukan, 15 diantaranya berupa jurnal.
4. **Kelengkapan unsur dan kualitas terbitan**: Prosiding diterbitkan oleh penerbit prosiding Internasional, yaitu IOP Conference Series, terindeks Scopus, J-Global, SJR= 0,18 e-ISSN: 1551-7616

Semarang, 1 Nopember 2021
Reviewer 1

Prof. Moses Laksono Singgih, MSc, PhD
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Unit kerja : Dept. Teknik dan Sistem Industri ITS

C-12

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Komponen Yang Dinilai	Nilai Maksimal Prosiding		Nilai Akhir Yang Diperoleh
	Internasional 30	Nasional ☐	
a. Kelengkapan unsur isi prosiding (10%)	3		2,0
b. Ruang lingkup dan kedalaman pembahasan (30%)	9		7,6
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	9		7,9
d. Kelengkapan unsur dan kualitas terbitan/prosiding(30%)	9		8,2
Total = (100%)	30		25,7
Nilai Pengusul = (20%)* 25,7 = 5,14			

Catatan Penilaian Paper oleh Reviewer:
1. Artikel ditulis sesuai dengan Author Guidelines (Title, Abstract, Introduction,Materials and Methods, Result and Discussion, Conclusion, Acknowledgement, References). Substansi artikel sesuai bidang ilmu pengusull/penulis pertama (Teknik Industri). Terdapat benang merah dalam struktur penulisannya.
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4. diterbitkan oleh penerbit prosiding Internasional, yaitu IOP Conferences Series: MSE terindeks Scopus, Inspec, CAS, ADS, SJR= 0,18 e-ISSN: 1551-7616

Surakarta, 26 Oktober 2021
Reviewer 2

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Unit kerja : Dept. Teknik Industri UNS

C-12

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : JURNAL ILMIAH

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☐ *Prosiding* Forum Ilmiah Nasional

Hasil Penilaian *Peer Review* :

Komponen Yang Dinilai	Nilai Reviewer		Nilai Rata-rata
	Reviewer 1	Reviewer 2	
a. Kelengkapan unsur isi jurnal (10%)	2,5	2,0	2,25
b. Ruang lingkup dan kedalaman pembahasan (30%)	8	7,6	7.8
c. Kecukupan dan kemutahiran data/ informasi dan metodologi (30%)	8	7,9	7,95
d. Kelengkapan unsur dan kualitas terbitan/jurnal (30%)	8	8,2	8,1
Total = (100%)	26,8	25,7	26,25
Nilai Pengusul (Penulis ketiga)	5,3	5,14	**5,25**

Semarang,

Reviewer 1

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Analysis of benzene exposure considering workers characteristic in the oil and gas industry

Attaqwa Y., Mahachandra M. ✉, Prastawa H.

Save all to author list

Industrial Engineering Department, Faculty of Engineering, Diponegoro University, Semarang, Indonesia

Abstract

Operations and processes in the oil and gas industry have hazardous chemicals. Hence the possibility of having a work accident is high. Chemicals that exist are produced by activities related to the oil and gas industry processes, one of which is benzene. Because it has a severe impact on occupational health and safety, benzene exposure must be measured. Measurements were run through risk analysis to assess Hazard Index (HI) and make predictions of benzene exposure by focusing on the characteristics of workers, which can worsen the effect of the exposure. This study elaborated on several workers'

characteristics from a literature study's human factors point of view. These characteristics were smoking, age, type of task, personal protective equipment use, exposure duration, regulations, hand washing habits, length of exposure, and nutritional status. Literature study results showed that regulatory characteristics, handwashing habits, and length of exposure were worsening the benzene exposure to workers. The other factors were in between agreed and disagreed in worsening the benzene exposure. These results perform as a base study in the further benzene analysis of oil and gas end distributor.

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Preface

To cite this article: 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **909** 011001

PREFACE

On behalf of organizing committee of International Conference on Advanced Mechanical and Industrial Engineering (ICAMIE) 2020, I would like to express my sincere gratitude to all participants and speakers who contribute to make this event a great success. This is the first time for this biennial series of conference which is hosted by Mechanical Engineering Department and Industrial Engineering Department – Engineering Faculty – Sultan Ageng Tirtayasa University, Cilegon – Banten Indonesia. This event is also supported by IOP Conference Series: Materials Science and Engineering.

ICAMIE 2020 was originally scheduled on July 8-9th at Cilegon city, Banten province, Indonesia. However, due to the government's regulation on social distance related to the pandemic of COVID-19 and the limitation of overseas flights, the onsite presentation was replaced by one-day online presentation at July 8th 2020 via Zoom, organized at Faculty of Engineering, Sultan Ageng Tirtayasa University, Cilegon – Indonesia in collaboration with a professional provider of online video conference .

It is well-known that the concept of Industry 4.0 spread out in every field, including the modern technology, energy, and system which are considered as the key factors for smart industrial transformation. However, this transformation is not without challenges which are required to be solved. For this purpose, ICAMIE 2020 addresses innovations, trends, and recent developments on *Sustainable Technology, Energy and System toward Smart and Green Industrial Transformation* which covers mainly in the fields of Mechanical and Industrial Engineering. There are two sessions of keynote presentations, each consist of two keynote speakers. At first session, an efficient modeling and simulation method and fuel economy standards and labels as the tools for energy efficiency and optimization are presented. Whilst at second session, comprehensive aspects for the implementation of industry 4.0 are discussed. ICAMIE 2020 also have over 100 oral presentations in video format from participants coming from different countries.

Over 100 abstracts have been selected after peer review. Most of them are published in this proceeding (IOP Conference Series: Materials Science and Engineering) and the others are published in specific journals indexed by Scopus.

On behalf of the committee of ICAMIE 2020, we would like to express our thanks for all authors and reviewers who contribute to this proceeding.

Hadi Wahyudi, ST., MT., Ph.D — Chairman ICAMIE 2020
Prof. Dr-Ing Asep Ridwan, ST., MT., IPM — Co-Chairman ICAMIE 2020

PREFACE

I, on behalf of Universitas of Sultan Ageng Tirtayasa, warmly welcome all distinguished authors, guests and participants of International Conference on Advanced Mechanical and Industrial Engineering 2020 (ICAMIE 2020) held on July 8th, 2020 in Faculty of Engineering Universiatas Sultan Ageng Tirtayasa, Banten Province, Indonesia. It is a great honour for us to share knowledge to all of you.

ICAMIE 2020 is organized by both Mechanical and Industrial Engineering from Faculty of Engineering, Universitas Sultan Ageng Tirtayasa. The theme of this conference is "Development of Sustainable Technology, Energy, and Systems toward Lean and Green Industrial Transformation". This year, ICAMIE aims to raise awareness of industry revolution 4.0 and higher industrial efficiency in all major aspects, to address challenges of the implementation of industry 4.0 principles, and to provide solution for them. Besides, this international conference is expected to enhance the possibility of collaboration among the participants and gain benefits of industry 4.0 application in some advanced countries like Taiwan, Germany and many other countries.

In this book of abstract, there are 126 abstracts compiled from different interesting manuscripts of various disciplines of knowledge, not limited to mechanical and industrial engineering. All the 126 manuscripts had been reviewed by some experts from all around the world namely experts from Japan, Australia, Malaysia, Germany, and Indonesia. The published abstracts have passed all required improvement including originality, significance and clarity of the purpose. Our big appreciation is addressed to the participants that have participated to this international conference. We strongly believe that all the manuscripts have potential to be published in the SCOPUS Journal, Q2 and Q4 for journals and IOP publisher for proceeding.

Reviewing process of the submitted abstracts in ICAMIE 2020 was a challenging yet interesting process and largely depend on the goodwill of the reviewers to review the abstracts for conference presentation and publication. We would like to extend our gratitude for all reviewers for their time and effort in reviewing all the submitted abstracts. Moreover, we also thank to the presenters and attendees for their involvement in this ICAMIE 2020. We hope you gain some insights and partners to collaborate further in the future.

Finally, we would like to share our big appreciation to the committee of ICAMIE 2020 that has put considerable efforts for the success of this event. We hope all of us enjoy this event and continue to strengthen our collaboration, friendship and scientific exchange to bring benefits for industries and other related institutions in the future.

Serang, June 30th, 2020
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Prof. Kaiwei Chu

(Shandong University)

Topic:

Discrate Particle Simulation of Complex Particle-Fluid Flows from Fundamentals to Applications.

Prof.T M Indra Mahlia

(University of Technology Sydney)

Topic:

Fuel Economy Standards and Labels: The Way Towards an Energy Efficient Automotive Transportation.

Prof. Dr.-Ing Hendro Wicaksono

(Jacobs University Bremen)

Topic:

How can Industry 4.0 Support Global Sustainable Development Goals?

Prof. Shuo-Yan Chou

(National Taiwan University of Science and Technology)

Topic:

The Implementation of Smart Industry and Smart Factory in Taiwan.

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SCHEDULE

No	Time (WIB)	Event	PIC
1.	08.30 – 09.00	Registration	OC
2.	09.00 – 09.15	Conference Chair Report	Hadi Wahyudi, Ph.D
3.	09.15 – 09.30	Opening Speech by UNTIRTA's Rector	Prof. Dr. Fatah Sulaiman
4.	09.35 – 09.40	Break for Preparing Session 1	OC
5.	09.40 – 10.15	Speaker 1: **Prof. Kaiwei Chu** Topic: **"Discrete Particle Simulation of Complex Particle-Fluid Flows from Fundamentals to Applications"**	Moderator
6.	10.15 – 10.45	Speaker 2: **Prof. T.M. Indra Mahlia** Topic: **"Fuel Economy Standards and Labels: The Way Towards an Energy Efficient Automotive Transportation"**	Moderator
7.	10.45 – 11.15	Q & A Session 1	Moderator
8.	11.15 – 11.20	Break for Preparing Session 2	OC
9.	11.20 – 11.50	Speaker 3: **Prof. Hendro Wicaksono** Topic: **"How Can Industry 4.0 Support Global Sustainable Development Goals?"**	
10.	11.50 – 12.20	Speaker 4: **Prof. Shou-Yan Chou** Topic: **"The Implementation of Smart Industry and Smart Factory in Taiwan"**	Moderator
11.	12.20 – 12.50	Q & A Session 2	Moderator
12.	12.50 – 13.00	Closing remarks	Hadi Wahyudi, Ph.D

Table of contents

Volume 909

2020

Previous issue Next issue

International Conference on Advanced Mechanical and Industrial engineering 8-9 July 2020, Banten, Indonesia

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Open all abstracts

Preface

Mechanical Engineering

OPEN ACCESS 012003

The effect of post-curing temperature on mechanical properties of coconut coir fiber reinforced polyester composite

S Rizal, A Junaidi, I Gunawan, Taufiqurrahman, J D Nasution, A Mataram, A B Ilham and Afriansyah

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A CFD simulation and experimental study: predicting heat transfer performance using SST k-ω turbulence model

C D Widiawaty, A I Siswantara, Budiarso, G G R Gunadi, H Pujowidodo and M H G Syafei

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OPEN ACCESS 012005

The cooling effect of polycrystalline type PV panels using perforated aluminum plates

I Bizzy, R Sipahutar, D Puspitasari, A Sofijan and M A Fajri

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OPEN ACCESS 012006

Passive cooling using perforated aluminum plate to improve efficiency on monocrystalline of 100 Wp photovoltaic

A Sofijan, Z Nawawi, B Y Suprapto, I Bizzy and R Sipahutar

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OPEN ACCESS 012007

Effect of cutting conditions on power demand and surface roughness through sustainable turning of mild carbon steel

Syah Risal, Rusdi Nur, Arthur Halik Razak and Yan Kondo

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Effect of gas pressure on conduit plasma atomization for fabricating spherical stainless steel powder

Dharmanto, Sugeng Supriadi, Ario Sunar Baskoro and Bambang Suharno

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The electrical energy usage of monitoring system at real-time using IoT as the primary policy of energy efficiency

Suhanto, Achmad Setiyo Prabowo, Rifdian Indrianto Sudjoko and Wiwid Suryono

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OPEN ACCESS 012010

Metallurgical performance of column and mechanical flotation as a rougher circuit in sphalerite ore flotation with %solid and frother dose variation

S Oediyani, A Muttaqin, D Haryono and R F Suwandana

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OPEN ACCESS 012011

Low cost prototype simulation of spectrum analyzer base on GNU radio and RTL-SDR

B.B. Harianto, Ade Irfansyah and Yuyun Suprapto

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Battery energy storage system as the optimal solution for underdeveloped, remote, outermost region: Pasi island study case

Donny Yoesgiantoro

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OPEN ACCESS 012013

Mathematical model for calculating the equilibrium point of the refrigerant circuit

A Daci and J Bundo

+ Open abstract View article PDF

OPEN ACCESS 012014

Monitoring and controlling electricity consumption using Wemos D1 Mini and smartphone

Wiwid Suryono, Achmad Setiyo Prabowo, Suhanto and Abdul Mu'ti Sazali

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OPEN ACCESS 012015

Effect of the surface of the rough pipe on the fluid flow rate

Oktarina Heriyani, Dan Mugisidi and Irfan Hilmi

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The effect of vortex generator on the approach value on forced draft type cooling tower

Oktarina Heriyani, Dan Mugisidi, P H Gunawan and Dwi Apriliana Putri

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+ Open abstract View article PDF

OPEN ACCESS 012024

Development of control systems on vacuum evaporators with 50 l capacity to reduce honey water content accordance to sni 01-3545-2004

N. Nazaruddin, Hapsoh and A I Darmawan

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Hybrid electric vehicle power consumption analysis in tropical area

Ghany Heryana, DA Sumarsono, Mohammad Adhitya, N Nazaruddin, Rolan Siregar, Fuad Zaenuri and Sonki Prasetya

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OPEN ACCESS 012026

A Performance study of a single basin double slope solar still with 45˚ of glass-cover slope angle in Indonesia

Caturwati Ni Ketut, Yusvardi Yusuf, Zaenal Arifin and Muhamad Fajar Komara

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OPEN ACCESS 012027

Camshaft modification on gasoline single cylinder engine to increase engine performance

Agung Sudrajad, Yusvardi Yusuf and Irwan Prasetyo

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OPEN ACCESS 012028

Particleboard characterization using sawdust from sengon wood, mahogany wood, bayur wood, and rice husk ash as composite fillers

Sunardi, Rina Lusiani, Iman Saefuloh, Erny Listijorini, Anggit Eka Sumarna, Moh. Fawaid and Yenny Meliana

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OPEN ACCESS 012029

Biodiesel characteristics of tuna fish bio-oil waste in the transesterification process with variation of reaction time and stirring speed

I Rosyadi, Ni Ketut Caturwati, Dhimas Satria, Haryadi and Muzaky

+ Open abstract View article PDF

OPEN ACCESS 012030

The study of corrosion behaviour api 5l steel in sea water using immersion test method

I Saefuloh, N Kanani, Y Rukmayadi, M I Noor, Y Yusuf, I Setiawan, S ula, S Abdullah and H A Notonegoro

+ Open abstract View article PDF

OPEN ACCESS 012031

Numerical and experimental analysis of drag force in medium speed train design

Jean Mario, Beny Halfina, Dimas Bahtera, Lukman Shalahuddin and Agus Windharto

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OPEN ACCESS 012032

Development of liquid smoke production process as a latex coagulant by utilizing a refrigeration machine

Riman Sipahutar, Diah Kusuma Pratiwi, Irwin Bizzy, Armin Sofijan and Baiti Hidayati

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OPEN ACCESS 012033

Stress analysis on the frame holder of generator translation motion on horizontal direction for sea wave power plant using finite element method (fem)

A. Indriani, Hendra, S. Yenni, W. Aswata, Rispandi, Hernadewita and A. Tanjung

+ Open abstract View article PDF

OPEN ACCESS 012034

Design of machine element in alpha type stirling machine innovation design based on plastic waste

Dhimas Satria, Imron Rosyadi, Rina Lusiani and Erny Listijorini

+ Open abstract View article PDF

OPEN ACCESS 012035

Design of pneumatic press machine for 250 page bundle book based on microcontroller arduino uno

Erny Listijorini, Haryadi, Dhimas Satria, Sunardi and Yusuf Azizi Rahman

+ Open abstract View article PDF

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Development of drying machine to improve palm sugar quality

Erwin Erwin and Meutia

+ Open abstract View article PDF

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Characteristics of aluminium AC4B reinforced with nano -SiC composites through stir casting methods

T N Fitri, W Narottama and A Zulfia

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Characterization of aluminium AC4B/Nano TiC composite with the variation of volume fraction of nano TiC reinforced through stir casting process

M K Adam and A Z Syahrial

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OPEN ACCESS 012039

2-D modelling of effect of free-stream turbulence on trailing edge vortex

Syaiful, Anggie Restue Saputra, Nazaruddin Sinaga and Bambang Yunianti

+ Open abstract View article PDF

OPEN ACCESS 012040

Minimization of transport costs in an industrial company through linear programming

V Prifti, I Dervishi, K Dhoska, I Markja and A Pramono

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Industrial Engineering

OPEN ACCESS 012041

Improvement of insurance agents performance using data mining in OV agency

A N Habyba and R Fitriana

+ Open abstract View article PDF

OPEN ACCESS 012042

Shipping cost optimization on the Indonesian sea tollway due to weather

M F Pradana, M I Hamdani and B Noche

+ Open abstract View article PDF

OPEN ACCESS 012043

Making of nusantara decorative motif creations necklace based on hdpe on type plastic waste

Desiana Nur Indra Kusumawati, Widyo Wibisono and K Wisnu Indra

+ Open abstract View article PDF

OPEN ACCESS 012044

Measurement of user satisfaction for web-base academic information system using end-user computing satisfaction method

Purwanto and P.B. Deden Hedin

+ Open abstract View article PDF

OPEN ACCESS 012045

Optimization of bi-objective permutation flow shop scheduling with electricity cost consideration

B Kurniawan and S Fujimura

+ Open abstract View article PDF

OPEN ACCESS 012046

Selection of supplier for the evaluation of procurement of special chemical using entropy method and topsis in xyz company

E R Wijaya and Rudianto

+ Open abstract View article PDF

OPEN ACCESS 012047

Management of information systems, implementation and their importance in Albanian enterprises

V Prifti, I Markja, K Dhoska and A Pramono

+ Open abstract View article PDF

OPEN ACCESS 012048

The implementation of lean construction and six sigma concepts in light brick installation: A case study in Cordova apartment project

Naniek Utami Handayani, Mochamad Agung Wibowo, Anita Mustikasari, Ilham Wahyu Nurwidanto and Drajat Akbar Dilaga

+ Open abstract View article PDF

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The manufacturing technology optimisation model: the crucial contribution of industrial mass-training in improving company performance

L. Sukarma, Franka Hendra, Riki Effendi and E. Mohamad

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Knowledge base integration management system quality, safety and environmental to improve organizational performance in construction company

Retno Apriyati and Yusuf Latief

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OPEN ACCESS 012051

Design and analysis of cell phone case from recycling plastic bottle

M T A Benhardy, A Solihin, E F Primaseta and T R Sahroni

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Design and analysis of new box frame for online motorcycle transportation

Avid Christa Nugraha, R Ferliadi, A Nurma Amelia and T R Sahroni

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OPEN ACCESS 012053

The measurement of customer satisfaction towards the service quality at xyz wholesale by using fuzzy service quality method

Chalis Fajri Hasibuan

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OPEN ACCESS 012054

The application of LPT, CEGA, and PSO method on flow shop scheduling with parallel machine

Y Muharni, A Irman, E Febianti, T E Rubyanti and N N Sofa

+ Open abstract View article PDF

OPEN ACCESS 012055

Fiscal incentive policy for coal downstreaming in Indonesia

Ragimun and Imran Rosjadi

+ Open abstract View article PDF

OPEN ACCESS 012056

Effect of passenger presence towards driving performance level using kss and cnc indicators

M Mahachandra, H Prastawa and A H Mufid

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OPEN ACCESS 012057

Identify product families using cluster analysis: case study in Passenger Car Radial (PCR) tire product

Rere Nugrahita and Isti Surjandari

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Minimize the potential failures in the wire rod production process using six sigma and multi attribute failure mode analysis method

Maria Ulfah, Ratna Ekawati and Nafila Amalia

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Analysis of benzene exposure considering workers characteristic in the oil and gas industry

Yusita Attaqwa, Manik Mahachandra and Heru Prastawa

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OPEN ACCESS 012060

Detection system and security monitoring of the storage room of liquid oil gas with zoning method

Suzuki Syofian, Guswan and Timor Setiyaningsih

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OPEN ACCESS 012061

Design of planning model for ERP system in warehouse management: an empirical study of public hospital in Indonesia

F D Utami, W Puspitasari and M Saputra

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OPEN ACCESS 012062

Evaluation criteria and ranking supplier raw materials waste paper with the methods ahp and topsis (case study paper company in west java)

Muhamad Sayuti, W Akda Zahrotul and Robin Perdana

+ Open abstract View article PDF

OPEN ACCESS 012063

Optimization of supply chain operation cost and gas usage quantity using non-dominated sorting genetic algorithm II (NSGA-II) Method

A Ridwan, A Bahauddin and R P M Naufal

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OPEN ACCESS 012064

Measurement of psychological impact of industrial engineering students in fulfiil of online learning outcomes using NASA-TLX method

Ani Umyati, Wahyu Susihono and Ade Sri Mariawati

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Study the use of shared power supply in mobile telecommunication station in Indonesia

B Budiman, F Farizal and D S Gabriel

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Implementation of lean manufacturing using waste assessment model model (WAM) in food industry (case study in usaha mikro kecil menengah (umkm) xyz)

E Febianti, A Irman and M Juliana

+ Open abstract View article PDF

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Identify factors that caused false and violation by motorcycle rider

Lovely Lady, Teguh Try Mulyo and Kulsum Kumino

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OPEN ACCESS 012068

Selection of IoT-based technology for electric smart meter on PLN Disjaya

Adi Mulyono and F. Farizal

+ Open abstract View article PDF

OPEN ACCESS 012069

Cost of quality system in passenger car plant: a methodology of implementation

W H Rahardjo, F Farizal and D S Gabriel

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OPEN ACCESS 012070

Evaluation of power plant reliability using index loss of load in the Suralaya power plant

Putro Ferro Ferdinant, Laila Nurdiana and Ade Irman

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Sentiment analysis of tokopedia application review to service product recommender system using neural collaborative filtering for marketplace in Indonesia

Restu Meifitrah, Irfan Darmawan and Oktariani Nurul Pratiwi

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Arief Faizin and Isti Surjandari

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Productivity measurement using Objective Matrix: case study in plate mill

N Wahyuni and R Alya

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OPEN ACCESS 012074

Food production performance measurement system using halal supply chain operation reference (SCOR) model and analytical hierarchy process (AHP)

I S Fauziyah, A Y Ridwan and P S Muttaqin

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OPEN ACCESS 012075

Framework of risk priority and risk mitigation approach for palm sugar reverse supply chain

N Ummi, Marimin, E Noor and A Iskandar

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Risk factors for rear-end collision: a systematic literature review

Fatin Saffanah Didin and Hardianto Iridiastadi

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Household solid waste composition and characterization in Indonesia Urban Kampong

Juntara Semilu Rosesar and Gabriel Andari Kristanto

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Development of Reverse Logistics Scenarios for Inorganic Waste Recovery in Grobogan Regency - Indonesia

M Hadiwidodo, B P Samadikun, A I Putri, S Sumiyati and B S Ramadan

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Agung Bayu Aji and Isti Surjandari

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Yanti Pasmawati, Alva Edy Tontowi, Budi Hartono and Titis Wijayanto

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Website library information system design using fast method

A Gunawan, N Wahyuni, H Setiawan, PB Katili and R Azla

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Development of set covering model for determining the open /closed facilities location and resizing capacity of fasilities

Utaminingsih Linarti, Cahaya Annisa' Fatonah and Annie Purwani

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OPEN ACCESS 012083

Designing a computerization management production system in PT Akrilik Kurnia Kencana using barcode

Rudy Vernando Silalahi, Ishak and Marciello

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Performance evaluation of yarn raw materials supplier using fuzzy data envelopment analysis approach (case study Batik Fabric Company in Sleman)

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Analysis and strategy of supply chain risk mitigation using fuzzy failure mode and effect analysis (fuzzy fmea) and fuzzy analytical hierarchy process (fuzzy ahp)

Dyah Lintang Trenggonowati, Maria Ulfah, Faula Arina and Chisti Lutfiah

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Increased productivity using *lean service* (Case study: regional drinking water company x)

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Hernadewita, Hendra, R. Kristianti, I. Asih, S. Dhimas and E.N.S. Yuliani

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Ade Irman, Y Muharni and Andri Yusuf

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Faula Arina, Maria Ulfah and Dyah Lintang Trenggonowati

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Ergo-innovative design of cow slaughter tool

Soewardi Hartomo and Putra Eufrade Maulana

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N Valentika, S Abdullah, Ilmadi, S I U Chasanah, A R Nuha, M Huda and V I Nursyirwan

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Fabrication of fluorine-doped tin oxide by using Indonesian local stannic chloride precursors with spin coating method

E Yustanti, G Fahmi, L H Lalasari, T Arini, L Andriyah, A Subhan, F Firdiyono and A Trenggono

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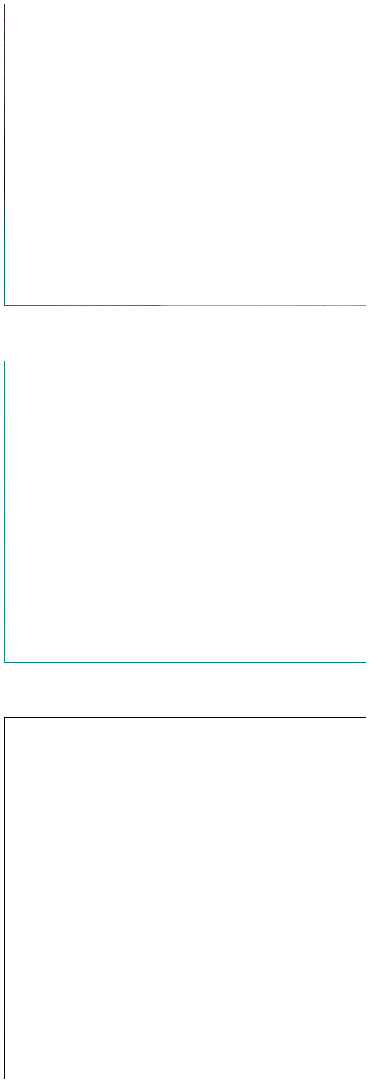

Analysis of Benzene Exposure Considering Workers Characteristic in The Oil and Gas Industry

by Heru Prastawa

Submission date: 29-Sep-2021 07:09PM (UTC+0700)
Submission ID: 1660578969
File name: Yusinta_Attaqwa_2020_ICAMIE_1.pdf (440.86K)
Word count: 4171
Character count: 23178

Analysis of benzene exposure considering workers characteristic in the oil and gas industry

IOP Conf. Series: Materials Science and Engineering **909** (2020) 012059 doi:10.1088/1757-899X/909/1/012059

Analysis of benzene exposure considering workers characteristic in the oil and gas industry

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Abstract. Operations and processes in the oil and gas industry have hazardous chemicals. Hence the possibility of having a work accident is high. Chemicals that exist are produced by activities related to the oil and gas industry processes, one of which is benzene. Because it has a severe impact on occupational health and safety, benzene exposure must be measured. Measurements were run through risk analysis to assess Hazard Index (HI) and make predictions of benzene exposure by focusing on the characteristics of workers, which can worsen the effect of the exposure. This study elaborated on several workers' characteristics from a literature study's human factors point of view. These characteristics were smoking, age, type of task, personal protective equipment use, exposure duration, regulations, hand washing habits, length of exposure, and nutritional status. Literature study results showed that regulatory characteristics, handwashing habits, and length of exposure were worsening the benzene exposure to workers. The other factors were in between agreed and disagreed in worsening the benzene exposure. These results perform as a base study in the further benzene analysis of oil and gas end distributor.

1. Introduction

Operations and processes in the oil and gas industry have hazardous chemicals; hence the possibility of having a work accident is high. Chemical work accidents in the course of carrying out work can threaten every worker to face occupational health and safety risks caused by his work. Case studies of workers in oil refineries investigating health hazards are critical to identifying health hazards for worker safety [1].

The oil and gas industry is the primary source of volatile aromatic hydrocarbons in the environment [2]. Benzene is the primary aromatic hydrocarbon compound whose presence is produced one of them by activities related to the oil and gas industry process. Benzene is a hazardous chemical classified as a class 1 carcinogen and mutagen that can be infected by humans and animals through dermal, oral, and inhalation exposure [3]. Benzene exposure to workplace workers mainly occurs through inhalation compared to dermal and oral [4]. The average benzene exposure in humans through inhalation has been reported to be around 50 to 80% [5]. Acute exposure to benzene concentrations can also affect fatigue, dizziness, headache, drowsiness, confusion, tremors, and loss of consciousness [7] [8]. Chronic exposure can cause more serious adverse health effects, such as myeloid leukemia, myeloma,

reduced production of red and white blood cells from the bone marrow, decreased immune system, central nervous system damage, slow reflexes, liver and kidney failure, and cancer [8].

This explanation reveals the problems faced in the oil and gas industry regarding benzene exposure. This study, therefore, aims as literature review to understand benzene exposure to humans considering the characteristics of workers who can exacerbate benzene exposure to workers to determine risks endanger health and safety at work.

2. Literature Review

2.1. Industrial Hygiene

The Occupational Safety and Healthy (OSHA) defines Industrial Hygiene as a science aimed at anticipating, recognizing, evaluating, and controlling environmental factors from the workplace conditions that may cause illness, health problems, and well-being, or significant inconvenience and inefficiency among the worker. Industrial hygienists as occupational safety and health professionals controlling the work environment against occupational health hazards that arise as a result of or during work. Industrial hygiene monitoring and analysis to detect the extent of worker exposure and then base any hazard controls on actual exposure data [6].

The science ergonomics studies and evaluates focuses on the design of a working system where humans work a full range of tasks, including lifting, holding, pushing, walking, and reaching. All work systems consist of human components, machine components, and the environment that interact with each other. The relationship between humans and the environment is handled by industrial hygienists [9].

2.2. Benzene

Benzene (C_6H_6) is a cyclic organic chemical compound usually found in an environment that is flammable, colorless with a distinctive aromatic fragrance that is volatile into the air. This compound is a natural part of crude oil, gasoline, and cigarette smoke as a source of exposure [10].

Benzene exposure to humans is unavoidable because it requires measurement of benzene that occurs in the industrial oil and gas environment. The procedure for analyzing air samples refers to NIOSH 1501 (Hydrocarbons, Aromatic). Sampling and analysis can be done through the collection of benzene vapor in worker breathing zone by put down a personal sampling pump (Figure 1) that has been installed charcoal tube (Figure 2) near the respiratory tract of the worker. Subsequently, chemical analyzes were performed using gas chromatography in Figure 3 [10].

Figure 1. Personal sampling pump

Figure 2. Charcoal tube

Figure 3. Gas chromatography

The Indonesian government's steps to minimize benzene exposure make regulations regarding limits on the value of chemicals that can expose workers while in the workplace. Based on the Minister of Manpower and Transmigration Regulation No. PER.13/MEN/X/2018 of 2011 concerning the Threshold Limit Value (TLV) of physical and chemical factors in the workplace, the recommended benzene TLV to prevent health impacts is 0.5 ppm. Measurements can be made with a risk analysis used to assess the Hazard Index (HI) [11].

2.3. Worker Characteristics

This study is based on several characteristics that are likely to affect benzene exposure. It is known from previous studies that smoking, age, type of task, PPE use, exposure duration, regulations, hand washing habits, length of exposure, and nutritional status are characteristics that can exacerbate benzene exposure in Table 1.

Table 1. Literature review result.

Location / Characteristics	+ / -	TBBM	SPBU	Oil Refinery
Smoking	+	[12]	[13] [14] [15] [16] [17] [18] [23] [24] [25] [26]	[17] [19] [20] [21] [22] [27] [28]
	-			
Age	+	[12] [29]	[15] [18] [30]	[21] [22]
	-		[17] [23] [24] [25]	[20]
type of task	+	[12] [31] [32] [33]		[34]
	-	[35] [36]	[36]	[36]
PPE use	+		[37]	[22] [23]
	-		[26]	
Duration exposure	+		[15] [37]	[21] [39] [40]
	-		[15] [24] [25] [26]	[27] [28]
regulations	+	[42]		
hand washing habits	+		[37]	
length of exposure	+		[42] [43] [44]	[39] [40]
nutritional status	+			[21]
	-			[27]

(+) Effect; (-) No Effect

2.3.1. Smoking habits

Research agrees that the more significant number of cigarettes smoked affects the levels of benzene that enters the body. The information on petroleum distribution location when considered smokers, a positive relationship was found between personal air exposure levels of ethylbenzene levels in urine samples [12]. The information on service station BTX levels for exposure to smoking subjects is higher than nonsmokers [18] [13]. Smokers are found to be significantly higher than nonsmokers [15]. In smokers, the SPMA value and the value of benzene are significantly higher than nonsmokers [14] [16]. The information on oil refinery personal exposure that smoking has an impact on air exposure, exposure is higher in smokers than nonsmokers ($P < 0.001$) [17] [19]. Smokers and nonsmokers show statistically significant differences and confirm that smoking is a major confounding factor when assessing benzene exposure to work [20]. Smoking habits of oil refinery workers are mostly light smokers [21]. As many as 41 people or 83.7% of 49 respondents had smoking habits [22].

Research does not agree that the increasing number of cigarettes smoked affects the levels of benzene that enters the body. There were no significant differences in smoking characteristics in the oil service station [23] [24] [25] [26]. There were no significant differences between smokers and nonsmokers in the oil refinery between employees exposed to and not exposed to benzene [27]. Whereas the other study, there was no significant difference in ttMA levels in respondents with smoking habits ($p = 0.559$) [28].

2.3.2. Age

Research that agrees that the older the workforce is, the higher the risk of benzene poisoning. The information on petroleum distribution age grouping shows that health effects increase from the age of workers is 40 years. Research shows that age has a strong relationship with the hematological index on the health of oil workers [12] [29]. The information on the service station, the average age is 40.5 years [15]. The exposure group's average age was 38 years, ranging from 20 to 57 years [18]. The age of oil refinery workers is most in the age range of 49-52 years [21]. Whereas the other study, the average age of respondents in this study is the tankers is 36 years [22]. Data were obtained from a questionnaire about age in the group studied $p < 0.05$ [30].

Research that disagrees that the older the workforce is, the higher the risk of benzene poisoning. The information on the service station, there was no significant dependence of Benzene in the air on age characteristics [17] [23] [24] [25]. The information on oil refinery research shows no significant difference between subjects exposed to work and the age of the worker [20].

2.3.3. Types of Tasks

Research that agrees that the filling task, the higher the risk of benzene exposure. The information on petroleum distribution this type of task was found to be the most important characteristic associated with exposure [32]. Research that agrees to the older the workforce is, the higher the risk of benzene tanker loading is the highest risk occupation at this facility [12] [33]. The highest lighted occupations (8 hours) TWA is maintenance workers who can be directly affected by benzene [31]. Based on the information on oil refinery, the most predictive independent variable of benzene exposure is work assignment [34].

Research that does not agree that the type of filling task the higher the risk of benzene exposure. The information on petroleum distribution 8-hour TWA type of task for low benzene within the working limit of gasoline component exposure [35] [36].

2.3.4. Use of Personal Protective Equipment

Research that agrees that the use of PPE can reduce benzene exposure through inhalation. The information on the service station most workers still do not use personal protective equipment when doing work [22] [23] [37].

Research that does not agrees that the use of PPE can reduce benzene exposure through inhalation. The information on service station based on the results of the study, no significant relationship PPE usage of gas station operators to the exposure of benzene in SPBU, Tuak Daun Merah Subdistrict, Kupang City (p-value > 0.05) [26].

2.3.5. Exposure Duration

Research that agrees that the number of years worked will affect the intake of benzene exposure that enters the body of the worker. The information on the service station, the average exposure duration is 16 years and 23 years [15] [37]. The information on an oil refinery, there was a significant correlation of exposure duration (p-value < 0.05) [38]. The working period of oil refinery workers is the most in 22-25 years [21]. The safe working period for a lifetime (30 years) is 6.1 years [40].

Research does not agree that the number of years worked affects the intake of benzene exposure that enters the body of the worker. The information on the service station, there is no significant dependence of benzene in the air on the characteristics of the length of service [17] [24] [25] [26]. The information on an oil refinery, there was no significant difference between the exposure duration of work between employees who are exposed to and not exposed to benzene [27] [28].

2.3.6. Regulations

Research that agrees that rules which are not followed are higher at risk. Regulation is a factor influencing the concentration of benzene exposure in gasoline storage and distribution facilities in developing countries [45].

2.3.7. Handwashing Habits
Research that agrees that lousy handwashing habits have a higher risk. The habit of washing hands in the Ciputat Timur gas station operator in 2017 was weak in terms of only 28 people (38.4%) [37].

2.3.8. Length of Exposure
Research that agrees that the longer working hours that occur to workers, the higher the risk. There was a significant correlation of working hours to levels of t, t-muconic acid urine (all variables, $p < 0.05$). The information on oil refinery this study concludes that the longer working hours that occur in workers, the higher levels of t, t-muconic acid urine [39]. The safe length of exposure for a lifetime of work (30 years) is 1.6 hours per day [40]. The information on service station Length of Exposure is 8 hours / day [42] [43] [44].

2.3.9. Nutrition Status
Research that agrees that the higher the weight will reduce the level of risk. The nutritional status of oil refinery workers is most in normal conditions [21]. Research that does not agree that the higher the weight will reduce the level of risk. There is no difference between abnormal nutritional status and significantly normal nutritional status between employees exposed to and not exposed to benzene [27].

3. Prospective Research
Perusahaan Pertambangan Minyak dan Gas Bumi (PERTAMINA) operates several TBBM (Terminal Bahan Bakar Minyak), one of which is the TBBM Semarang Group. According to The Agency for Toxic Substances and Disease Registry (ATSDR) [10], benzene is a hazardous chemical in oil that has a severe impact on health and safety. So the TBBM Semarang Group's environment will not be separated from the possibility of benzene exposure to workers, which can have a severe impact on work health and safety. Because it has a severe impact on occupational health and safety, benzene exposure must be measured. If more than the TLV has been determined, then corrective action is needed for health and safety. Measurements can be made for making predictions that will occur due to the presence of benzene exposure in the work environment by looking at the characteristics of workers who can exacerbate benzene exposure. When looking at literature studies for benzene exposure, some of the characteristics of workers must be considered. Some characteristics can worsen the occurrence of benzene exposure, affecting the health and safety of workers. So it is essential to conduct the assessment of benzene exposure in the TBBM Semarang Group.

4. Conclusion
Operations and processes in the oil and gas industry have hazardous chemicals, one of which is benzene that can be infected by humans. Hence, the possibility of a work accident is high for workers. After looking at the related review literature, it can be concluded that the study agreed and disagreed about the characteristics that could exacerbate benzene exposure to workers. Table 2 shows that (+) is a researcher who agrees and (-) is a researcher who disagrees. The characteristics of smoking, age, type of task, PPE use, exposure duration, and nutritional status have researchers who agree and disagree that these characteristics can exacerbate benzene exposure to workers. Regulatory characteristics, handwashing habits, and length of exposure were agreed to worsen benzene exposure to workers. So one of which PERTAMINA business units is the TBBM Semarang Group very important can be monitoring.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9