

## Abstracts of Presentations for WISH 2014

----- **Keynote speech** -----

**(K-1)** Globalization and Localization of Occupational Safety and Health

**Yoshiyuki Fukuzawa**

**Executive Director**

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Globalization and standardizations are going on in the world of OSH such as OSHMS, but working culture is different country by country. OSHMS is a top-down system while Japanese working culture is characterized by bottom-up system such as Kaizen, 5S and KY Activities which contribute to Japan's strong competitive power. The tools for bottom-up system are incorporated into the JISHA-OSHMS standards. JISHA survey shows that JISHA-OSHMS is functioning in upgrading the OSH level and positive impact on production system as well since the tools become good basis in hazard identification and countermeasures to fight against residual risk at workplaces. Safety culture is a part of working culture and these are inseparable. We have to carefully consider the diversity of working culture in adopting OSH "Global Standards". Localization of "Global Standards" might be necessary for effective implementation of the standards. Flexibility should be a key word in formulating global standards on OSH.

**(K-2)** **The Outlook for Global Unity of Hazardous Area in Korea**

**Sang-Won CHOI**

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The Republic of Korea adopted the international standard, IEC (International Electrotechnical Commission) under the catch phrase "World-wide acceptance of a single standard, a single certificate and a single mark". But Europe adopted the ATEX (Atmosphere Explosion) Directive, which creates a new method of approving explosion-protected equipment for Europe. Furthermore, modifications to the National Electrical Code (NEC) and Canadian Electrical Code (CEC) have created changes and complications in the marking and approvals of new explosion-protected products. Now, due to the ATEX Directive, manufactures have the opportunity to build and test explosion-protected equipment to the new Directive 94/9, which is based on performance testing. This new system may revolutionize the hazardous area industry as well as trade throughout Europe by freeing up manufactures to use

new inventive types of equipment and construction standards. Instead of marking the practice of consolidating approvals for globalized products simpler, Canada and US have gone in different directions. This may confuse many parties who manufacture, specify, install, and inspect explosion-protected equipment. In this presentation gives an overview of the requirements in each other's different national standards for electrical equipment in potentially explosive atmospheres, for example, gas grouping, temperature classification, protection symbols, and hazardous zones. And there is now a considerable choice of methods of protection applicable to electrical equipment for use in potentially explosive atmospheres of petroleum industries in Korea.

- The company that imports the explosion proof equipment/material is responsible for ensuring that the explosion proof equipment/material has the KCs mark.
- Mixing of Divisions and Zones should not be permitted. However, one bay of a building may be classified in the Zone system while an adjacent bay is classified in the Division system if they are separated.
- The choice between the use of the Division and the Zone system is more difficult than what initially appears. A decision to change or stay with the present system is a question of economics, worker training, maintenance, and comfort levels in using systems which are known and prove in the industry.

I think that the above-mentioned problems have all Asian countries including Japan as well as Korea. Therefore, I kindly suggest making a discussion group for global unity of hazardous area among Asian countries, for example the GHS (Globally Harmonized System of Classification and Labeling of Chemicals) in the same way.

**————— Session 1: Workplace environment and mental health —————**

**(1-1) Performance evaluation of portable aerosol measuring instruments used for nanomaterial aerosol measurements**

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**2. National Institute of Advanced Industrial Science and Technology**

Nanomaterial particles exhibit a wide range of size distribution through the formation of agglomerates/aggregates. To assess nanomaterial exposure in the workplace, accurate measurements of particle number size distributions are needed. Two instruments were developed for measuring particle size distribution. One is a portable scanning mobility particle sizer (NanoScan SMPS, TSI Inc.), which measures particle number concentration and size distribution between 10 to 420 nm. The other instrument is an optical particle sizer (OPS, TSI Inc.), which measures particle number concentration and size distribution between 300 to 10,000 nm in dusty environments. The performance evaluation of the instruments was conducted through intercomparison with a widely used scanning mobility particle sizer (SMPS) and optical particle counter (OPC) using nano-TiO<sub>2</sub>

powder as test aerosols. The results showed that there were obvious differences in the number size distributions measured by the new and old SMPSs, suggesting that the inlet of the new SMPS (NanoScan) acted as a disperser of the agglomerates and the number concentration increased through the breakup of the agglomerates. The effect of particle dispersion by the inlet was not negligible. Furthermore, the number size distributions measured using OPS corresponded well to the measurements made by OPC

**(1-2) A Development and Validation of the Slip Resistance Tester**

**Seung-Ju Choi, Jae-Suk Park, Sang-Won Choi, Jin-Hyun Kim**

**Occupational Safety and Health Research Institute of KOSHA, Korea**

To prevent slip accidents, the most common cause of injury at work, it is important to measure accurate slip resistance quantitatively. Many previous researchers have agreed with the need of device and test method which represent the human slip biomechanically. However, existing devices to measure the slip resistance indicate different values on the same slippery condition because they control different biomechanical parameters. This study aims to identify the complex parameters of human slip and develop a slip resistance tester based on the previous studies and human gait experiments. Also for validation, we evaluate this tester used floor with ASTM F2508 which is comprised of four different standard surfaces.

**(1-3) A Study on the Factors Influencing on Job Stress of Korean Workers**

**Yujeong Lee, Seong Rok Chang**

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The elderly population (age 65 years and above) of the Republic of Korea exceeded 11% of the entire population in 2011; thus, Korea's "aging society" is becoming an "aged society". An aging society is characterized by an increase in the elderly population; the average age of industrial workers is concurrently increasing. In order for Korea to overcome the phenomena of becoming an aged society, older adults must participate in the workforce to balance out the population; workers' mental health must also be maintained. In addition, influential factors in employees' capabilities and degrees of importance thereof should be identified in advance to maintain mental health. To evaluate Korean workers' job stress, this study measured job stress and identified its contributing factors. The Korean Occupational Stress Questionnaire was completed by 5,708 Korean workers. Results indicated that job stress increased with age. It was also found that employees in administrative positions had lesser job stress than site workers, and workers who performed intellectual tasks had lesser job stress than workers who performed physical labor. Job stress was additionally observed to contribute towards

overall work ability. Lack of reward, interpersonal conflict, and the organizational system are all factors in work-based stress. Results showed that the strongest determining factors in the job stress of Korean workers were physical state and workplace culture.

----- **Session 2: Safety engineering and its applications** -----

- (2-1) **Global harmonization of safety regulation for the use of industrial robots**  
- **Permission of collaborative operation and the related study in JNIOOSH –**

**Tsuyoshi SAITO<sup>1</sup>, Toshirou HOUSHI<sup>2</sup>, Hiroyasu IKEDA<sup>1</sup> , Kohei OKABE<sup>1</sup>**

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In December 2013, the ministry of health, labour and welfare of Japan(MHLW) decided to revise the safety regulation for the use of industrial robots so that collaborative operations which are allowed in ISO standard of industrial robots can be perform at work sites. As an example to show the participation of JNIOOSH in global harmonization of the ordinance on industrial safety and hygiene in Japan, this presentation reports the progress of a research study which has been conducted by JNIOOSH from 2011 to the present in accordance with a request of MHLW to examine the necessity and effect of this revision.

At the first phase of this study, a questionnaire survey was carried out among domestic robot manufactures and users. This revealed their potential demands for the collaborative operations and possible problems, especially insufficiency of their risk assessment. As the second phase, JNIOOSH therefore proposed to MHLW that the provision of technical documents including risk assessment results and residual risk information should be also required in the new regulation. This proposal was reflected with partial modifications. In order to support appropriate propagation of the new regulation, as the third phase, a model of robot system which can demonstrate concrete measures to fulfil the requirements for the collaborative operations in the ISO standard is produced.

- (2-2) **Analysis of Thermal Characteristics of Electric Wiring for Load Group in Cattle Barns**

**Doo Hyun KIM, Sang-Ok YOO , Sung Chul KIM, Dong Kyu HWANG**

**Chungbuk National University, Korea**

The study is purposed to analyze the thermal characteristics of electric wirings depending on the number of operating load by installing four types of electric wirings that are selected by surveying the condition for the electric fan, automatic waterer and halogen warm lamp that were installed at cattle barn in different years. In order to achieve the goal in this paper, it surveyed the condition of 64 cattle barns and conducted a test at a cattle barn (Beonyoung cattle barn). The condition survey covered inappropriate design, construction and misuse on electric facility, electric wiring mostly used, and

measured mode of load current (the most frequently appearing electrical current). The survey results showed that the design, construction and misuse revealed that 62.5% were inappropriate. While the test showed that the mode of load current increased as the installation year went backward. Accordingly, the cattle barn manager increased the capacity of the circuit breaker, which accelerated insulation degradation of electric wire's sheath and resulted in high possibility for electrical fires in the long run. Therefore, the electric wiring work for the cattle barn has to consider the mode of load current depending on the installation year.

**(2-3) Optimal multi-floor plant layout based on the mathematical programming**

**Chang Jun Lee**

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In the fields of researches associated with plant layout optimization, the main goal is to minimizing the costs of pipelines for connecting equipment. However, what is lacking of considerations in previous researches is to handle safety distances for preventing domino impacts on a complex plant. The mathematical programming formulation can be presented as considering safety distances and economic benefits for solving the multi-floor plant layout problem. Under the risks of physical explosion, the safety distance must be considered to generate more reasonable and safe plant layouts. To consider the safety distance, a consequence analysis is employed to calculate the probability curve for the explosions of all equipment. The objective function of this study consists of two steps. The first is to minimize the costs (piping costs) connecting facilities in the process. The second is to minimize the explosion impacts under given conditions and a process. MINLP (Mixed Integer Non-Linear Programming) solvers can be performed to determine the optimal multi-floor process plant layout. The liquefaction process of an LNG-FPSO is illustrated to verify the efficacy of this study.

**----- Session 3: Safety and health in construction industry -----**

**(3-1) Actual condition survey of noise/vibration exposure in construction workers**

**Takeshi Sasaki, Nobuyuki Shibata, Naomi Hisanaga, Eiji Shibata, Hitoshi Kubota,  
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Recently, about half of workers' compensation of occupational noise-induced hearing loss in Japan are rendered by construction industry. According to our questionnaire survey, construction workers who frequently used noise/vibration outbreak tools indicated higher number of complaints about low hearing function than construction workers who did not used such tools. To clarify the actual situation and to make the causes out we examined the noise and hand-arm vibration during the job with various hand-held tools or machine tools used by construction workers.

### **(3-2) Analysis of Labour Accidents in Tunnel Construction and Proposals for Prevention Measures**

**Naotaka KIKKAWA<sup>1</sup>, Kazuya ITOH<sup>1</sup>, Tomohito HORI<sup>1</sup>, Yasuo TOYOSAWA<sup>1</sup>  
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At present, almost all mountain tunnels are excavated and constructed utilizing the New Austrian Tunneling Method (NATM) in Japan. This tunneling method was advocated by Prof. Rabcewicz from Austria in 1964. In Japan, this method has been applied to tunnel construction since around 1978, after which there has been a subsequent decrease in the number of fatalities and casualties in tunnel construction. However, there is still a relatively higher incidence of labour accidents caused during tunnel construction than when compared to incidence rates in the construction industry in general. In tunnel construction, rock fall events at the cutting face, are particularly characteristic of the types of accident that occur.

In this study, we analyse labour accidents that possess the characteristics of being a rock fall event at a work site, which were collected by the Association of Nihon Tunnel Construction Sub-Contractors. We also propose accident prevention measures against rock fall events by considering the mechanisms of such events and the theory of NATM.

The contents of this study are summarized as follows:

- (1) It is clear that many of the labour accidents due to rock fall events happen when workers set off explosive charges or install steel arch supports in the cutting face during tunnel construction using the mountain tunneling method, especially NATM. In addition, it was found that the dimensions of the fallen rock are on average 1.0m in length, 0.6m in width and 0.3m in thickness, and that these relatively small-scale and few rocks are the cause of deaths or injuries to workers.
- (2) Prevention measures that were proposed against labour accidents due to rock fall events during tunnel construction include shotcreting the cutting face, bolting to the cutting face, removing rock masses in the cutting face, drilling the cutting face for drainage, measuring the displacement of the cutting face, sufficient lighting in order to observe the cutting face, and protecting workers directly using nets, mats and man cage guards and individual protection kits.
- (3) In the prevention measures against labour accidents due to rock fall events during tunnel construction, shotcreting the cutting face is very effective because it can control any weakness in the integrity of the mountain rock, protect against exposing mountain rock to the air, and makes it easier to observe new cracks and deformations in the rock face, etc. In addition, shotcreting the cutting face is very useful in terms of construction and economic aspects. It is, however, more important to use shotcreting in combination with other prevention measures because some labour accidents due to rock fall events occurred even after shotcreting had been implemented. The cause of such accidents is

thought to be insufficient thickness in the shotcreting or a weakening in cohesive strength due to the upwelling of groundwater.

**(3-3) Weighting Factor of Consciousness between the Main Contractor and Subcontractors  
for Establishing Effective Risk Management in the Construction Industry**

**Ki Sang Son , Nam Kwon Eun)**

**Seoul National University of Science & Technology, Republic of Korea**

An accident prevention plan at a construction site is deemed necessary for better risk evaluation and management in Korea. Accidents occurring at construction sites affect all parties, such as the owner, the main contractor, the subcontractors, and the labor force. Therefore, analyzing the relationships between the main contractor and subcontractors is very important to estimate the risks at a site.

There are several different aspects concerning risk management between them.

Every type of work has its own risks, which is why every type of work done by a subcontractor alone should be evaluated in terms of the risk level. The main contractor should provide the subcontractor with a risk evaluation report to prevent accidents at all times.