List of Dissertation Abstract (Department of Artificial Environment)

Name	Supervisor	Title	Abstract
Yamamoto Rieko	Shiraishi Toshihiko	A Study of a Controllable and Gait Assistive Orthosis for Lateral Fall Suppression	Lateral falls during walking in individuals with hemiplegia due to stroke constitute a critical issue, often resulting in severe fractures. However, existing assistive devices have limited practicality due to their weight and size, and no device has specifically addressed lateral fall prevention. In this study, we developed a compact, wearable gait-assistive device capable of real-time adjustment of lateral sole height, employing a small brake utilizing magnetorheological (MR) fluid. Walking experiments conducted with healthy adults (n=17) indicated the device's potential effectiveness in preventing lateral falls and confirmed the reliability of the measurement system used to evaluate device efficacy.
Inoue Kazuki	Kumasaki Mieko	Effect of cocrystallization on the combustion and detonation characteristics of fuel materials and oxidizers for energetic materials.	This study investigated the effect of cocrystallization on the combustion and detonation characteristics of energetic mixture of fuel and oxidizer. Using sodium perchlorate as oxidizer, five energetic cocrystals were synthesized and characterized. The results revealed that cocrystallization results in better burning performance than the mixture of parent materials. Cocrystallization was also applied to ammonium nitrate and the results showed that cocrystallization is effective in improving three drawbacks of ammonium nitrate: hygroscopicity, phase transition and low burning performance. Results of detonation test suggested that cocrystallization enhanced detonability of energetic mixtures.

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Udagawa Makoto	Shibutani Tadahiro	Estimation Methods of Seismic Design Margins for Piping Systems in Nuclear Power Plants	The seismic ground motions observed during the 2011 off the Pacific coast of Tohoku Earthquake, etc. exceeded the expected magnitude assumed at the time of construction of nuclear power plants in a few periodic zones. Since then, assuming significant increases of the design basis of seismic ground motions, the seismic safety of nuclear power plants has been reviewed or under review. In the seismic evaluations of the piping systems of nuclear power plants, the existing seismic design guidelines and codes are based on the elastic design, even though the plastic deformation is initiated due to increased seismic ground motions. The dissipation of vibration energy owing to the elastic–plastic behavior of piping systems is not considered in principle, and their dynamic response is calculated conservatively. Furthermore, to ensure the conservatism of the seismic evaluations, the period broadening of the response spectrum of the earthquake ground motion, the setting of the equivalent number of seismic loading cycles in the fatigue evaluation, and the design fatigue curves, etc. are determined. Therefore, the magnitude of seismic ground motions or the number of seismic loading cycles may exceed the design assumptions at the time of construction of nuclear power plants, and even when the seismic evaluation results may not satisfy the seismic design guidelines and codes. In such cases, large seismic design margins of actual piping system failures have been qualitatively confirmed in many experiments because of the large

			conservatism in the seismic evaluations according to the seismic design guidelines and codes. The objective of this study is to quantitatively estimate the seismic design margins in the existing seismic design guidelines and codes focusing on piping system failures subjected to large seismic motions using analytical approaches. For the developments of analytical approaches, the effect of vibration energy dissipation due to the elastic-plastic behavior of piping systems and the effect of decrease in the dominant frequency due to the decrease in the stiffness of the piping system, etc. are considered in detail. In addition, piping systems in long-term operated nuclear power plants undergo aging degradations such as cracking and wall thinning. Because these aging degradations potentially affect seismic safety, they must be considered to comply with the nuclear regulatory authority's implementation guide for aging-related measures. Therefore, in this study, the analytical approaches consider wall thinning, which significantly reduces the stiffness of piping systems and leads to large strain ranges and ratcheting strains due to seismic loads. Furthermore, to accurately evaluate failures in high-strain regions and multi-axial strain states, focusing on monotonic tensile and cyclic loading tests of plate specimens, improvements of material constitutive laws and low-cycle fatigue evaluations based on the Gurson–Tvergaard–Needleman model are performed. Subsequently, for piping elements subjected to static cyclic loads and piping systems subjected to dynamic cyclic loads, the effects of the material constitutive laws on the accuracy of the analytical approaches were evaluated.

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Hatanaka Shintaro	Nakano Ken	Study on wear mechanism of rubbers in sliding contact with rough surfaces	Automobile tires require high friction and low wear for safety and sustainability. Appropriate material design guidelines are essential, as rubber friction and wear performance are generally contradictory. In this thesis, the modeling of contact and friction for viscoelastic solids linked the sliding contact conditions to the rubber friction characteristics. Then, experimental analyses, based on a systematic classification of rubber friction and wear phenomena, elucidated the wear mechanisms. Finally, theoretical and experimental analyses were integrated to derive design guidelines for achieving high friction and low wear from mechanical and material perspectives.
Sasaki Shigeyo	Kameya Takashi	Study of variability factors in laundry tests	To develop a method for testing the cleaning of clothes stains in response to recent changes in the washing environment in real homes and to speed up the determination of cleaning test results, we clarified the factors behind the variation in cleaning rates, etc., that arise due to differences in the washing method for clothes and the physical properties of the soiled fabric. We found cleaning test conditions that can reproduce the cleaning rates in real homes. In addition, we demonstrated that the probability density functional method could be used to quantitatively compare and evaluate the daily fluctuations, which could not be fully evaluated using the conventional indicator of cleaning rate, including the factors of variation, thereby contributing to the speed-up of result determination.

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Takada Noriko	Kobayashi Takeshi	A Study on Toxicity of Surfactants to Aquatic Crustaceans: A Surface Activity Approach to the Effects of Water Quality and Biodegradation	Surfactant activity can be measured by the adsorption of surfactant molecules to the air/water interface by surface tension. This adsorption ability causes toxicity by adsorbing on the gill surface of aquatic animals such as Daphnia magna and fish. Since surfactant performance is a physicochemical property of surfactants, it is affected by changes in the molecular form of surfactants, such as interactions with other substances such as water hardness and structural changes due to biodegradation. These effects were examined with the change in surfactant activity and its effect on aquatic toxicity.