

Course Syllabi

1. INDU-00026 CEMENTS AND NANOMATERIALS

2. Instructor:

- Christian Americo Cruzat Contreras

3. Bibliography

- Nanotecnología. Ciencia a escala atómica y molecular., Márquez Díaz, Jairo Eduardo. , 2007
- Cemento: fabricación, propiedades, aplicaciones,, Fritz K., 1973
- Introducción a la nanotecnología, Charles P. Poole, Frank J. Owens., 2007
- Manual tecnológico del cemento, Duda W, 1977
- Environmental nanotechnology: applications and impacts of nanomaterials., Wiesner, Mark and Bottero, Jean-Yves., 2007

4. Specific Course Information

a. Trata en forma descriptiva y práctica sobre la nanotecnología, maquinarias, equipos, procesos, técnicas de análisis y control de calidad en lo más importante de los procesos de fabricación del cemento y del hormigón. El curso se ocupa inicialmente, en la fabricación de cemento donde se tratan cada una de las etapas del proceso productivo hasta la obtención del producto final y de sus aplicaciones específicas, fundamentado en la nuevos materiales y aplicaciones de nanomateriales. La Nanotecnología es una disciplina interdisciplinaria que se emplea en la síntesis, diseño y fabricación de dispositivos y materiales a esta escala nanométrica (1 a 100 nm). Ingeniería Química tiene como necesidad de obtener productos y procesos industriales que estén relacionados y vinculados con la aplicación de nanotecnología y la industria de la fabricación del cemento. El curso de Nanotecnología e Ingeniería Química abarca los fundamentos básicos de la nanotecnología y la ingeniería química en aplicaciones cementicios, incluyendo los principios y la teoría detrás de la fabricación de dispositivos nanométricos y el diseño de procesos industriales. Los temas principales que se abarcaran incluyen la nanociencia y la nanotecnología, la termodinámica, la cinética química, la tecnología de procesos, la ingeniería de materiales, la ingeniería de biomateriales y la relación de estas aplicaciones en la industria y la química del cemento. El curso también se centrará en la aplicación de los principios y teorías aprendidos en situaciones prácticas. entender e interpretar los resultados de los ensayos y procedimientos de control de calidad en el cemento y hormigón con relación a la normativa internacional como son las normas ASTM (Sociedad Americana de Pruebas de Materiales) y las normas técnicas ecuatorianas dictadas por el INEN que regulan y controlan la fabricación de cemento y hormigón fresco en el país. La asignatura de Tecnología de Cementos contribuye con el perfil de egreso de la carrera.

b. Prerequisites:

- INDU-00038 I2: Polymers
- INGE-00027 I2: Extractive metallurgy

5. Learning Objectives of the Course

a. The general objective of the course is for the student to be able to understand, identify and know the norms, technologies and operations involved in the manufacture of cement and the obtaining of nanomaterials. All this through master classes and by carrying out technical field visits to cement plants and nanotechnology synthesis laboratory. Added to the realization of laboratory practices, where students will be able to observe, understand and apply the good practices. In addition to

maintaining the communication and interrelation between the University and the productive sector, in order to improve their professional preparation, all this according to the graduate profile of the chemical engineering career in numbers 11, 12, 13 and 14. - Understand the technology and unitary operations that are applied and used in the processes of manufacture of the cement and the concrete. - To know and interpret the norms, requirements and tests that are carried out to determine the physical, chemical and mechanical behavior of the different types of cement that are marketed in the country and its specific applications. - To identify and determine the different types of nanometric materials that can be used in the chemical industry, as well as to differentiate the techniques of synthesis and analysis of this type of materials. - To acquire the necessary skills and skills p • to achieve good communication, problem solving and teamwork, in the processes involved in the industrialization of cement and the application of nanomaterials.

b. Learning Outcomes

1. It identifies the different types of nanometric materials and determines how they can be used in the industry to obtain nanotechnological applications. in addition, it differentiates the techniques of synthesis and analysis of this type of nanometric materials.
2. It identifies the different types of nanometric materials and determines how they can be used in the industry to obtain nanotechnological applications. in addition, it differentiates the techniques of synthesis and analysis of this type of nanometric materials.
3. It acquires the skills and ability in communication, problem solving and teamwork, by carrying out technological research, virtual and laboratory practices that involve contributions to the knowledge of the processes of industrialization of cement and concrete.
4. It comprises the physical and chemical characteristics and the behavior of the different types of cement and concrete in fresh and hardened state, in the aspects of resistance, durability and quality. it knows the application of unitary processes and operations that are of common use in many industries such as: - systems of crushing, grinding and transport of materials. - thermochemical processes. -heat transfer. -fuel preparation. -mass balances and energy
5. It comprises the theoretical-practical concepts and technology applied to the cement and concrete manufacturing process and the interaction between the manufacturing process and its influence on the properties and quality of cement, the application of which is based on the preparation of mortar and/or concrete as construction material.
6. It comprises the physical and chemical characteristics and the behavior of the different types of cement and concrete in fresh and hardened state, in the aspects of resistance, durability and quality. it knows the application of unitary processes and operations that are of common use in many industries such as: - systems of crushing, grinding and transport of materials. - thermochemical processes. -heat transfer. -fuel preparation. -mass balances and energy
7. It comprises the theoretical-practical concepts and technology applied to the cement and concrete manufacturing process and the interaction between the manufacturing process and its influence on the properties and quality of cement, the application of which is based on the preparation of mortar and/or concrete as construction material.

6. Course Topics

1. General and description of the cement manufacturing process
2. Primary materials and clinker
3. The chemical of the cement

4. Introduction to nanotechnology, synthesis and properties.
5. Concrete and nanotechnology, characterisation and applications