

COMPETENCY PROFILE:

# CHEMICAL ENGINEER

## ROLE OVERVIEW

The foundation of chemical engineering lies in subjecting raw materials to processes that convert them into specialized products and materials. Chemical engineers conduct research, develop, and enhance processes, including designing and selecting equipment, and provide technical and management services to manufacturing plants, helping them convert raw materials into end products safely and efficiently.

The role entails diverse responsibilities depending on the industry and sectors. Professionals in this role typically conduct scientific research to develop innovative chemical processes and products. They are involved in changing the chemical properties of materials in a controlled environment. They participate in Quality Assurance and Quality Control procedures to ensure industry standards and regulatory compliance. Moreover, they optimize chemical processes to enhance efficiency and productivity while implementing continuous process improvement initiatives.

Chemical engineers with expertise in these areas are highly sought after in various organizations and industries. They find opportunities in pharmaceuticals, petrochemicals, materials development, and manufacturing sectors. Additionally, they may work in research institutions, government agencies, consulting firms, and educational institutions.

Professionals must possess technical, personal and professional competencies to succeed in this role. Personal and professional competencies like problem-solving, teamwork, attention to detail, and clear communication are essential for collaborating in multidisciplinary teams, grasping complex issues, and explaining technical ideas to varied audiences. On the other hand, technical competencies such as technical proficiency in chemical engineering principles, process modelling and simulation, data analysis, and knowledge of advanced tools and software are essential for conducting cutting-edge research and designing efficient chemical processes. A successful chemical engineer in this role continuously seeks to expand their knowledge and stay updated with the latest developments and industry trends to contribute effectively to their organization's success.

## ALSO KNOWN AS:

- Chemical Process Control Engineer
- Chemical Process Engineer
- Chemical Project Engineer
- Research Chemical Engineer

## NATIONAL OCCUPATIONAL CLASSIFICATION:

- 21320 – Chemical engineers

## EDUCATION AND EXPERIENCE

- A bachelor's degree in chemical engineering or a related discipline is required. This degree provides a broad understanding of chemistry, physics, mathematics, and specific chemical engineering principles like process engineering and thermodynamics, preparing students for entry-level roles in various environmental sector industries, including sustainable manufacturing, renewable energy, air pollution control, and water treatment and management.
- Consider a master's degree or doctorate in chemical engineering or a related field for further specialization, research, or academic positions. Advanced degrees delve into specialized areas like biochemical engineering, nanotechnology, and process systems engineering, focusing on research and developing new engineering approaches.
- In Canada, chemical engineers must be licensed by a provincial or territorial association of professional engineers to approve engineering drawings and reports legally. The licensing process ensures engineers adhere to high standards of professionalism and ethics, requiring completion of an accredited program, three to four years of supervised work experience, and passing a professional practice exam.
- Complete three to four years of supervised work experience post-graduation. This essential phase allows for applying academic knowledge in practical settings, gaining engineering practice experience, and understanding the ethical implications of engineering work.
- After meeting work experience and exam requirements, engineers can register as Professional Engineers, enhancing their credibility and allowing them to take on leadership roles such as project supervision and mentoring junior engineers.
- Stay engaged in lifelong learning through workshops, seminars, and further education to keep up with the rapidly evolving field of chemical engineering. Continuous professional development expands expertise and supports career advancement.

## TECHNICAL



### Research and Development

Applies scientific methods and techniques using empirical and measurable observation in their research to improve, correct, or increase knowledge in a field of study to solve specific problems.

- Research industrial processes or operations to develop or improve products.
  - Keep current on new chemical engineering technologies, breakthroughs, or competitive products, read current literature, attend meetings or conferences, or talk with colleagues.
  - Research chemicals and applications to develop new materials with improved properties.
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### Quality Assurance and Quality Control

Follows appropriate processes, as directed by global engineering standards, industry best practices, and company specifications to ensure quality is maintained throughout operations.

- Establishes quality control guidelines for the production process to develop quality control standards.

- Design and operating systems to control quality to drive issue resolution and long-term design robustness in coordination with production engineering.
  - Coordinates production activities with other functional units, such as procurement and production, to ensure standardization and consistency of processes and products.
  - Ensures that all personnel are aware of the quality assurance and quality control guidelines and can comply with them.
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## **Chemical Process Engineering Software**

Utilizes specialized chemical process engineering software for conducting studies essential to fulfilling project or product obligations.

- Uses chemical process engineering modelling and simulation software tools to model the behaviour of chemical reactions to meet desired specifications.
  - Design, analyze, and monitor chemical processes and systems using relevant software to test and ensure safe operation.
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## **Process Improvement**

Analyzes, innovates, and refines processes, systems, and practices to drive positive change and optimize performance, improving efficiency and quality.

- Conducts process analysis to identify weaknesses and implement relevant changes that optimize production processes to reduce waste.
  - Analyzes operational data to evaluate operations, processes, or products to gain insights into current process performance.
  - Participates in cross-functional teams to identify production and operational cost-saving opportunities.
  - Uses production methodologies, such as lean manufacturing and just-in-time (JIT) manufacturing, along with process improvement techniques and tools to enhance the quality, reliability, and cost-efficiency of manufacturing.
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## **Engineering Design**

Develops and approves the technical aspects of the planning and design of engineering project[s] to ensure projects are constructed safely, efficiently, and effectively.

- Develops measurement and control systems for chemical plants, utilizing data from laboratory experiments and pilot plant operations.
- Design and test chemical processing and associated plants and equipment to ensure the chosen equipment suits the intended process.
- Adjusts product designs to ensure that products or parts of a project meet organizational and regulatory requirements.
- Defines the engineering-related problem or opportunity and potential risks and benefits of project proposals to senior management and stakeholders so that the project proposal can be approved and implemented.

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## **Project Team Management**

Oversees a team of professionals to effectively and efficiently produce the required output to ensure project[s] are completed on time and within budget.

- Develops project plans and set milestones to facilitate successful project completion.
- Implements corrective actions when projects veer off course by providing technical solutions to deliver projects on time.
- Ensures that available resources are appropriately allocated to ensure resources are used at total capacity.
- Documents insights gained from project execution to improve risk mitigation strategies in future projects.

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## **Troubleshooting**

Identifies, solves, and reports on operating problems and inefficiencies in current equipment, processes, or systems to determine effective solutions.

- Addresses issues with new or existing products related to design, materials, or processes to enhance manufacturing efficiency.
- Works with the appropriate parties to design, install, or troubleshoot electrical equipment for reliability and maintenance.
- Documents problems and their resolutions to prevent recurrence or enable swift future resolution.
- Identifies and analyzes electrical system issues to develop effective troubleshooting strategies to minimize downtime and improve efficiency.



## Problem-Solving

Identifies problems, uses logic, judgment, and evidence to evaluate alternative scenarios, and recommends solutions to achieve a desired goal.

- Analyzes operational data to evaluate operations, understand trends and potential areas of concern, and take appropriate action where required.
  - Analyzes project metrics to understand trends and potential areas of concern to take appropriate actions where required.
  - Considers several possible explanations or alternatives for a situation, anticipates potential obstacles, and develops contingency plans to overcome them.
  - Uses appropriate management principles, processes, and tools to solve problems.
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## Collaboration

Engages in professional collaborative efforts with team members, including sharing information and expertise, utilizing input from others, and recognizing others' contributions to work towards common goals.

- Shares relevant and valuable knowledge, experience, or expertise to aid team members in accomplishing their objectives more efficiently or effectively.
  - Provides team members with constructive feedback and perspective to aid in completing a task or goal.
  - Develops and maintains effective working relations with stakeholders, individuals, and agencies to encourage cooperative partnerships.
  - Liaises with intra-departmental teams to establish priorities and provide general engineering support.
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## Attention to Detail

Reviews completed work by monitoring and checking information, efficiently organizing tasks and resources, or all areas involved in achieving an objective.

- Provides accurate and reliable feedback when reviewing others' work to ensure consistent deliverables.
- Scrutinizes models, tests, and simulation results to ensure validity and accuracy in results or findings.
- Routinely expresses concern that procedures and standards are followed thoroughly to complete tasks.
- Provides accurate, consistent information on all pieces of work to ensure reliable results.

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## **Communication**

Positively directs outcomes by delivering communication that results in a better understanding of goals and objectives, captures interest, and gains support for immediate action.

- Verbally conveys complex technical information accurately, clearly, and effectively to communicate technical operations and results.
- Shares relevant and valuable knowledge, experience, or expertise to aid team members in accomplishing their objectives more efficiently or effectively.
- Provides process design and communicates relevant supporting information to development and construction teams working on projects.
- Creates and evaluates technical reports and presentations, ensuring they meet quality standards for both internal and external viewers.



## Health, Safety, and Environment (HSE) Compliance

Conducts site inspections, oversight, and reporting to verify compliance with regulatory standards, internal policies, procedures, and client expectations.

- Observe and inspect the workplace to ensure compliance with applicable regulations and internal policies and procedures.
- Assess the safety, health, and environmental aspects of processes and projects to meet the requirements of the various jurisdictions.
- Ensures engineering personnel are adequately equipped in safe work gear to prepare for emergencies and reduce injuries.
- Supervises all hazardous work performed by personnel to ensure safety procedures are followed.

## Regulatory Compliance

Adheres to specific regulations, codes, and legislation within a defined jurisdiction to ensure the health and safety of others.

- Consults with different government agencies to secure regulatory approvals and permits.
- Reviews and applies relevant regulations, legislation, and standards to ensure the project complies with them.
- Participates in developing internal policy and procedures to ensure all legal requirements conduct assessments.
- Ensures others know their roles in ensuring organizational/project activities comply with relevant legal and regulatory frameworks.