Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Machines and devices of chemical and oil refining industries

PROCESSES OF PROCESSING HIGH MOLECULAR COMPOUNDS

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	***First (undergraduate)***
Branch of knowledge	*13 Mechanical engineering*
Specialty	*133 Industrial engineering*
Educational program	*Computer-integrated technologies of chemical engineering equipment design*
Discipline status	*Selective*
Form of education	*daytime*
Year of training, semester	*4th year, 7th autumn semester, 3rd year accelerators, 7th autumn semester*
Scope of the discipline	*4 credits*
Semester control/ control measures	*Assessment, MKR, Calculation work*
Lessons schedule	*http://rozklad.kpi.ua/Schedules/ScheduleGroupSelection.aspx*
Language of teaching	*Ukrainian*
Information about head of the course / teachers	*Lecturer/ Practical: associate professor of the Department MAHNP, Associate Professor A.R. Stepanyuk,, < arstepaniuk@gmail.com >*
Placement of the course	https://ci.kpi.ua/uk/syllabuses-bac-disciplines/#place

Program of educational discipline

The purpose of the educational discipline is to form students' competence:

- *the ability to carry out calculation and design, modernization and operation along the entire life cycle of equipment, and disposal of waste from deep processing of organic raw materials.*

1.2. The main tasks of the academic discipline.

***knowledge**:*

- *modern approaches, methods and techniques, solving problems in design, maintenance, modernization and operation along the entire life cycle of equipment, and disposal of waste from deep processing of organic raw materials*

skill:

- *using scientific and technical information, regulatory documents, professional knowledge, perform calculation and design, modernization and operation along the entire life cycle of equipment, and disposal of waste from deep processing of organic raw materials*

1. **Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)**

The list of disciplines, the mastery of which is necessary for the student (requirements for the level of preparation) for successful mastering of the discipline:

- *Processes and equipment of chemical technologies*

the list of disciplines that are based on the results of training in this discipline.:

- *Pre-diploma practice*
- *Diploma design*

2. Content of the academic discipline

Topic 1.1.Chapter 4. Extrusion processing methods.

Topic 1.1. Equipment for the preparation of melt.

The principle of operation and design features of extruders, the physical model of extrusion, the principle of calculation using the stepwise approximation method are considered.

Topic 1.2. Modeling of melt preparation processes.

Mathematical models of the processes taking place in separate zones of the extruder (feeding, melting, homogenization), algorithms for their calculation are considered. Gives the principle of building a general algorithm for calculating worm extruders, choosing the geometry of working bodies and modes of polymer processing.

Topic 1.3. Processes and equipment for forming products.

The peculiarities of product formation and the design of forming heads, the generalized algorithm of their calculation, the functional connection of the extruder and the forming head, operating characteristics and operating points are considered.

Topic 1.4. Processes and equipment for heat treatment of products.

The principles of modeling heat treatment processes and the design features of the equipment are considered. The algorithm for calculating heat treatment processes is considered using the example of a polymer pipe cooling scheme.

3. Educational materials and resources

3.1 Basic

1. *Synopsis of lectures. Access from the screen:http://login.kpi.ua.*
1. *Synopsis of lectures. Access from the screen:http://login.kpi.ua.*
2. *Radchenko L.B. Processing of thermoplastics by the extrusion method: Science. manual. - K.: IZMN, 1999. - 220c.*
3. *Radchenko L.B. Sivetsky V.I. Basics of modeling and designing worm extruders: Science. manual. - K.: Polytechnic, 2002. - 152c.*
4. *Piven O.N., Grechana N.A., Chornobylskyi I.I. Thermophysical properties of polymer materials. Directory. - K.: Higher School, 1975. - 317 p.*
5. *Thermophysical and rheological characteristics and friction coefficients of filled thermoplastics. Handbook / Under the editorship of Yu.S. Lipatova - K.: Science. dumka, 1977. - 244 p.*
6. *"Industrial polymers" and "Fundamentals of technology for the production of polymer materials": a study guide to the discipline and practicals for students of the Faculty of Chemistry / edited by I. O. Savchenko, V. G. Syromyatnikov. – K.: Kyiv University Publishing and Printing Center, 2012. – 112 p.*
7. *Radchenko L.B. Processing of thermoplastics by the extrusion method: Science. manual. - K.: IZMN, 1999. - 220c.*
8. *Rheological properties of non-Newtonian fluids: laboratory workshop on the discipline Modeling of processes and equipment for the preparation of environments and obtaining biotechnological materials [Electronic resource]: training. manual for students specialty 133 "Industrial mechanical engineering", specialization "Engineering, equipment and technologies of chemical and oil refining industries" / KPI named after Igor Sikorskyi; comp.: A.R. Stepaniuk, G.K. Ivanytskyi - Electronic text data (1 file: 1.4 MB). – Kyiv: KPI named after Igor Sikorskyi, 2019. – 38 p.(Full text, pdf, 1.43 Mb)*
9. *Study of rheological properties of polymer melts. Methodical instructions for the performance of laboratory work by students of the specialty: 133 Industrial mechanical engineering, specialization: Engineering, equipment and technologies of chemical and oil refining industries, educational and qualification level specialist in the discipline "Equipment for the synthesis and processing of*

polymeric materials": [Electronic resource] / „ KPI named after Igor Sikorsky"; structure. M. P. Shved, A. R. Stepaniuk. - Kyiv: NTUU "KPI", 2017. 23 p.Full text, pdf, 1.12 Mb

3.2. Auxiliary

10. *Radchenko L.B. Sivetsky V.I. Basics of modeling and designing worm extruders: Science. manual. - K.: Polytechnic, 2002. - 152c.*

Educational content

4. Methods of mastering an educational discipline (educational component)

Lecture classes

Lectures are aimed at:

- *provision of modern, comprehensive in-depth knowledge of the discipline, the level of which is determined by the target attitude to each specific topic;*
- *provision of critical creative work together with the teacher in the process of work;*
- *education of acquirers of professional qualities and development of their independent creative thinking;*
- *awareness of global trends in the development of science in the field of processes and technology of primary gas and oil processing;*
- *awareness of the methods of processing information resources and determining the main directions for solving specific scientific and technical problems;*
- *teaching research materials in a clear and high-quality language, observing structural and logical connections, explaining all the given terms and concepts available for perception by the audience.*

No s/p	***The name of the topic of the lecture and a list of the main questions (a list of didactic tools, references to the literature and tasks on the SRS)***	***Number hours***
	Chapter 1. Basic methods of polymer processing	
	Topic 1.1. Classification of methods and their implementation in technological schemes	
1	*Properties of polymers. Classification of the main methods of processing them into products (extrusion, injection molding, blow molding, pneumatic and vacuum molding, pressing, calendering).* *Literature: 1, 5, 6.* *Tasks at SRS: Technological diagrams illustrating the main methods of processing (extrusion, injection molding, blow molding, pneumatic and vacuum forming, pressing, calendering), and equipment for their implementation.* *Literature: 2-10.*	*1-2*
	Chapter 2. Extrusion methods of polymer processing	
	Topic 2.1. Equipment for the preparation of melt	
2	*Characteristics of melt preparation equipment. Extruders. Principle of action, classification, design features.* *Literature: 5-10.* *Tasks on SRS: Design features of extruders.* *Literature: 5-10.*	*3-4*
3	*A physical model of the processes in the worm channel (feeding, melting, homogenization). The principles of constructing algorithms for calculating extruders as a whole as a sequence of algorithms for calculating individual processes.* *Literature: 5-6.* *Task on SRS: Generalized algorithm for calculating extruders.* *Literature: 5-10.*	*5-6*
	Topic 2.2. Modeling of melt preparation processes	

4	*Mathematical model of the feeding process in the worm channel and its analysis.* *Literature: 5-10.* *Task on SRS: Algorithm for calculating the feeding process in the worm channel.* *Literature: 5-6.*	*7-8*
5	*Mathematical model of the melting process in the worm channel and its analysis.* *Literature: 5-10.* *Task on SRS: Algorithm for calculating the melting process in the worm channel.* *Literature: 5-6.*	*9-10*
6	*Mathematical model of the process of homogenization in the worm channel and its analysis. Selection of dimensions and construction of the geometry of the working organs of the worm extruder.* *Literature: 2-10.* *Task on SRS: Algorithm for calculating the homogenization process. Algorithm of the design calculation of the worm extruder.* *Literature: 5-6.*	*11-13*
	Topic 2.3. Processes and equipment for forming products	
7	*Design features of molding heads and principles of their calculation.* *Literature: 2-10.* *Task on SRS: Generalized algorithm for calculating forming heads.* *Literature: 5-6.*	*14-16*
8	*Functional connection of the extruder and the forming head. Operating characteristics and operating points.* *Literature: 5-6.* *Task on SRS: Optimizing the geometry of the working bodies of extruders.* *Literature: 2-10.*	*17-19*

Laboratory classes

- *The main purpose of the cycle of laboratory works:*
- *gaining experience in conducting studies of kinetic regularities of the main processes of chemical technology and the corresponding equipment;*
- *systematization and consolidation of knowledge of fundamental equations of transfer of mass, energy, quantity of motion and general principles of their solution for specific processes;*
- *systematization and consolidation of knowledge about the physical and chemical foundations of thermal processes and the principles of calculation of the relevant devices;*
- *systematization and consolidation of knowledge about the constructions and principles of operation of heat exchange devices and the peculiarities of their calculation;*
- *summarized results.*

No s/p	***The name of the topic of the laboratory session and the list of main questions (list of didactic support, references to the literature and tasks on the SRS)***	***Number hours***
1	*Introductory lesson. Safety technique. Acquaintance with the equipment*	*2*
	Chapter 1. Basic methods of polymer processing	
	Topic 2.3. Processes and equipment for forming products	
2-3	*Study of a worm extruder*	*4*
	Literature 8.	
	SRS: Repeat topic 1.1.	
	Literature 1-8.	
4	*Study of the worm extruder head*	*2*
	Literature 7.	

	SRS: Repeat topic 1.1.	
	Literature 1-8.	
5	*Study of the worm extruder head*	
	Literature 7.	
	SRS: Repeat topic 1.1.	*2*
	Literature 1-8.	
6	*Study of the cooling zone of the worm extruder*	
	Literature 7.	
	SRS: Repeat topic 1.1.	
	Literature 1-8.	
7-8	*Study of the pulling device of the worm extruder*	*4*
	Literature 7.	
	SRS: Repeat topic 1.1.	
	Literature 1-8.	

5. Independent work of student

Independent work makes up 50% of the study of the credit module, which includes preparation for the credit. The main task of independent workacquirers- this is the deepening of worldview and scientific knowledge in the directions specified in the lectures, by searching for the necessary information, forming perseverance and creative search in the formation of working hypotheses.

No s/p	***Title of the topic, list of didactic support, references to the literature and tasks on the SRS***	***Number hours***
	Chapter 1. Theoretical foundations of polymer production processes.	
	Topic 1.1. Properties of polymers as high molecular weight compounds.	
1	*Thermophysical properties of polymers.* *Literature: 1-4.*	*6*
2	*Main characteristics and areas of application.* *Literature: 1-4.*	*6*
3	*Labeling requirements* *Literature: 1-4.*	*6*
4	*Polymerization equipment* *Literature: 1-4.*	*6*
5	*Equipment for curing individual polymers* *Literature: 1-4.*	*6*
	Chapter 2. Theoretical foundations of polymer processing processes	
	Topic 2.1. Equipment for polymer processing processes	
6	*Design features of extruders.* *Literature: 1-5.*	*6*
7	*A generalized algorithm for calculating extruders.* *Literature: 1-5.*	*6*
8	*Design features of extruders.* *Literature: 1-5.*	*6*
9	*Repeat sections 1-2 to MKR*	*18*

6. Calculation work

The main task of the calculation life is the deepening of worldview and scientific knowledge in the directions specified in the lectures, by searching for the necessary information, forming perseverance and creative search in the formation of working hypotheses.

Policy and control

7. Policy of academic discipline (educational component)

Rules of attending classes and behavior in classes

Attending classes is mandatory.Gettersare obliged to take an active part in the educational process, not to be late for classes and not to miss them without valid reasons, not to interfere with the teacher conducting classes and not to be distracted by activities unrelated to the educational process.

Rules for assigning incentive and penalty points

- *incentive points can be awarded by the teacher exclusively for the performance of creative works and working hypotheses.*
  But their sum cannot exceed 25% of the rating scale.
- *Penalty points are not provided within the academic discipline.*

Policy of deadlines and rescheduling

In case of academic debts arising from the academic discipline or any force majeure circumstances,acquirersshould contact the teacher to coordinate the algorithm of actions related to solving existing problems.

Policy of academic integrity

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism refers to the absence of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible tips and write-offs when writing tests, conducting classes.
The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details:https://kpi.ua/code

Policy of academic behavior and ethics

Gettersmust be tolerant, respect the opinion of others, formulate objections in the correct form, adequately support feedback during classes.
Standards of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details:https://kpi.ua/code

8. Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline according to the working study plan:

Semester	Training time		Distribution of study hours				Control measures		
	Credits	Acad. hours	Lectures	Practical	Lab. do	SRS	MKR	RR	Semester control
8	4.0	120	36	—	18	66	1	1	test

The student's rating in the discipline consists of the points he receives for:

The rating of the applicant from the credit module consists of the points he receives for work in practical classes, lectures and MKR.

Semester control is credit.

System of rating (weighted) points and evaluation criteria

A weighted point for questions in lectures is 2 points

The weighted score for laboratory classes is 3 points each;

The weighted score for MKR is 5 points

Weighted score for calculation work is 7 points

Weighted score for credit is 40 points

Completeness and signs of completion of the task onMKR	*Points*
The task is fully completed	*10*
Minor flaws	*9*
Untimely completion of the task	
Poor performance of the task	*6*
Failure to complete the task	*0*

Weight score forcalculation work10 points

Completeness and signs of task completion	*Points*
The task is fully completed	*10*
Minor flaws	*9*
Untimely completion of the task	
Poor performance of the task	*6*
Failure to complete the task	*0*

Criteria for evaluating the performance of laboratory work

Completeness and signs of task completion	*Points*
Preparation for work	
The task is fully completed	*2*
Minor flaws	*1.5*
Untimely completion of the task	
Poor performance of the task	*1.0*
Failure to complete the task	*0*
Performance of the work task	
The task is fully completed	*2*
Minor flaws	*1.5*
Untimely completion of the task	
Untimely completion of the task	*1.0*
Poor performance of the task	*1.0*
Failure to complete the task	*0*

Thus, the rating semester scale for the credit module is:

*R =18*2+4*3+5+7+40=36+12+5+7+40 = 100 points*

According to the results of the educational work in the first 7 weeks, the "ideal achiever" should score 40 points. At the first attestation (8th week), the applicant receives "credited" if his current rating is at least 20 points.

According to the results of the educational work for 13 weeks of training, the "ideal achiever" should score 90 points. At the second attestation (14th week), the applicant receives "credited" if his current rating is at least 40 points.

The maximum number of points is 100. To receive credit from the credit module "automatically" you need to have a rating of at least 60 points.

A necessary condition for admission to credit is a rating of at least 40% of the rating scale (R), i.e. 40 points.

Applicants who scored a rating of less than 0.6 R during the semester, as well as those who want to improve the overall rating, complete a credit test. At the same time, all the points they received during the semester are cancelled. Test tasks contain questions that refer to different sections of the credit module. The list of assessment questions is given in Chapter 9.

To obtain a passing grade, the sum of all rating points R received during the semester is converted according to the table:

Scores	***Rating***
95...100	*perfectly*
85...94	*very good*
75...84	*fine*
65...74	*satisfactorily*
60...64	*enough*
RD<60	*unsatisfactorily*
Admission conditions not met	*not allowed*

9. Additional information on the discipline (educational component)

An approximate list of questions submitted for semester control

- *Give the types of classification of high molecular weight substances.*
- *Give the classification of high molecular weight substances according to the origin of high molecular weight compounds (MHC).*
- *Give the classification of high molecular weight substances according to the nature of the Navy*
- *Give the classification of high-molecular substances according to the type of reaction of obtaining IMS*
- *Give the classification of high-molecular substances in relation to the action of elevated temperatures of the Navy.*
- *Give the classification of high molecular weight substances depending on the composition of the main (main) chain of the Navy*
- *Analyze the structure of polymer macromolecules*
- *Analyze the concepts of thermoplastics and thermoplastics.*
- *Analyze the concept of mechanical hysteresis.*
- *Analyze the concept of polyolefins and their properties.*
- *Analyze the concepts of polystyrene and its copolymers and their properties.*
- *Analyze the concept of polyvinyl chloride and its copolymers and their properties.*
- *Analyze the concept of polyvinyl acetate plastics and their properties.*
- *Analyze the concept of polymethyl methacrylate and their properties.*
- *Analyze the concept of polyamides and their properties.*
- *Analyze the concept of polyethylene terephthalate and their properties.*
- *Analyze the concept of fillers and composite materials based on polymers and their properties.*

- *Analyze the concept of polyolefins and their properties.*
- *Analyze the concept of polyolefins and their properties.*
- *Analyze the concept of polyolefins and their properties.*
- *Analyze the principle of operation and structural schemes of extruders.*
- *Analyze the use of worm extruders.*
- *To analyze the principle of action and the design scheme of a single-worm extruder of single-worm extruders.*
- *Analyze the scheme of the melting process of polymer material in a standard screw.*
- *Analyze the designs of screws with one-way threading.*
- *To analyze the principle of operation and structural schemes of multistage extruders.*
- *To analyze the principle of action and the necessity of using gear pumps in cascade disk-gear extrusion.*
- *Analyze the principle of action and the general structure and principle of action of a worm extruder.*
- *Analyze the principles of modeling extruders.*
- *Analyze the principle of operation and structural schemes of roller machines.*

Working program of the academic discipline (syllabus):
Compiled by associate professor of the department, candidate of technical sciences, associate professor Andrii Stepaniuk

Approved by the department (protocol No. 20 dated 06/20/2024)

Agreed by the Methodical Commission of the faculty (protocol No. 11 dated 28.06.2024)