

X. Suggested Reading

- Bourne MC. 2002. *Food Texture and Viscosity: Concept and Measurement*. Academic Press.
- Deman JM. 1976. *Rheology and Texture in Food Quality*. AVI Publications.
- Mohsanin NN. 1989. *Physical Properties of Plant and Animal Material*. Vol. I, II. Gordon and Breach Science Publications.
- Steffe JF. 1992. *Rheology and Texture in Food Quality*. AVI Publications.

I. Course Title : Agricultural Waste and By-Products Utilization

II. Course Code : PFE 604

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint and equip the students with the techniques of utilization of agricultural waste and by-products and also about development of value added products from wastes.

V. Theory

Unit I

Conversion processes: Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process. Agricultural wastes as paper, boards and fuel.

Unit II

Briquetting: Briquetted fuel from husk, hull and other wastes selection, design of briquetting machines. Utilization of shell, stem and stalk: Production of activated carbon. By-products of agro-industries: Rice mill, oil mill, cattle feed mill, valuable constituents and composition. Utilization of rice husk: Production of silica and cement from rice husk. Stabilization and storage of rice bran, extraction of rice bran oil.

Unit III

By-products of oil refining: Fatty acids/soap stock, wax and gum, characteristics and utilization. Rice germ and broken rice. Production of starch and infant food, industrial uses of starch. By-products of oil milling: Oil cake and defatted oil cake, cattle feed and industrial uses. Utilization of starch and other industrial wastes: Microcrystalline cellulose, production of ethanol, wastes of tapioca starch industries, thippi-utilization as fuel, extraction of starch by hydrolysis, utilization of starch for food, adhesives and feed purposes.

Unit IV

By-products of sugar industry: Sugarcane tops, bagasse, molasses and pressmud, utilization as animal feed. By-products of fruits and vegetables based agro-industries: Mango seed kernel and pineapple waste.

VI. Practical

Exercises on stepped grate and fixed grate rice husk furnaces, waste fired furnace, briquette machine, production of alcohol from waste materials, production and testing of paperboards and particleboards from agricultural wastes.

VII. Learning outcome

Student's capability to develop processes for effective utilization of wastes generated through milling and processing of food materials.



VIII. Lecture Schedule

S.No.	Topic	No. of Lectures
1.	Introduction to by-products and waste generation in agricultural production and processing system. Generation of agricultural and agro industrial by-products/ wastes, their properties, on site handling, storage and processing.	2
2.	Thermo-chemical conversions, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process.	3
3.	Combustion and its types, theory, basic requirements for combustion, extraction.	2
4.	Gasification process, gasifiers- types and their functioning, factors affecting gasification process.	2
5.	Densification process, methods to densify materials, factors to be considered.	1
6.	Utilization of wastes for paper production, production of particle board.	1
7.	Briquetting process, methods, design of machinery used for briquette formation, basic requirements, factors affecting briquetting from husk, hull and other wastes selection.	2
8.	Utilization of rice husk: Production of silica and cement from rice husk, Stabilization and storage of rice bran, extraction of rice bran oil.	2
9.	Utilization of shell, stem and stalk: Production of activated carbon.	1
10.	By-products from rice milling operations, rice husk, rice bran, utilization in different materials.	3
11.	Waste from oil mill, cattle feed mill, their valuable constituents and composition, utilization.	2
12.	By-products of oil refining: Fatty acids/soap stock, wax and gum, characteristics and utilization.	1
13.	Rice germ and broken rice. Production of starch and infant food, industrial uses of starch.	1
14.	By-products of oil milling: Oil cake and defatted oil cake, cattle feed and industrial uses.	1
15.	Utilization of starch and other industrial wastes: Microcrystalline cellulose, production of ethanol, wastes of tapioca starch industries.	2
16.	Thippi-utilization as fuel, extraction of starch by hydrolysis, utilization of starch for food, adhesives and feed purposes.	2
17.	By-products of sugar industry: Sugarcane tops, bagasse, molasses and press mud, utilization as animal feed.	2
18.	By-products of fruits and vegetables based agro-industries: Mango seed kernel and pineapple waste.	2
	Total	32

IX. List of Practicals

S.No.	Experiment	No. of Practicals
1.	To Determine of moisture content of biomass.	1
2.	To Determine of ash content of biomass.	1
3.	To determine Proximate analysis of biomass/waste/residue.	2
4.	Exercises on stepped grate and fixed grate rice husk furnaces.	2
5.	Exercises on waste fired furnaces.	1
6.	Exercises on combustion calculation.	1
7.	To study the briquetting machine.	1



S.No.	Topic	No. of Lectures
8.	To study the various quality parameters of briquettes.	1
9.	To study the production of alcohol from waste materials.	1
10.	To study the production of paper boards and particle boards from agricultural wastes.	2
11.	To determine the properties of paper boards and particle boards from agricultural wastes.	2
	Total	15

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- ASAE Standards. 1984. *Manure Production and Characteristics*.
- Bor SL. (Ed.). 1980. *Rice: Production and Utilization*. AVI Publ.
- Chahal DS. 1991. *Food, Feed and Fuel from Biomass*. Oxford & IBH.
- Chakraverty A. 1989. *Biotechnology and other Alternative Technologies for Utilisation of Biomass/Agricultural Wastes*. Oxford & IBH.
- Donald LK and Emert HG. 1981. *Fuels from Biomass and Wastes*. Ann. Arbor. Science Publ.
- Srivastava PK, Maheswari RC and Ohja TP. 1995. *Biomass Briquetting and Utilization*. Jain Bros.
- USDA. 1992. *Agricultural Waste Management Field Handbook*. USDA.

I. Course Title : Mathematical Modeling in Food Processing

II. Course Code : PFE 605

III. Credit Hours : 3+0

IV. Aim of the course

To acquaint and equip the students with the mathematical modeling techniques and their applications in food processing

V. Theory

Unit I

An overview of the modeling process. Introduction to mathematical, correlative and explanatory models. Formulation, idealization and simplification of the problems.

Unit II

Probability models, series and linear mathematical approximation, dynamic and interacting dynamic processes.

Unit III

Applications of mathematical modelling techniques to food processing operations like parboiling, convective drying, pasteurization, dehydration, shelf-life prediction, fermentation, aseptic processing, moisture diffusion, deep fat drying, microwave processing, infrared heating and ohmic heating.

Unit IV

Stochastic finite element analysis of thermal food processes. Neural networks approach to modelling food processing operations.

VI. Learning outcome

Student's capability to develop models for food processing operations for prediction and control of operations.