Industrial Alcohol Technology Handbook

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Production of industrial alcohol is an age old practice. But with time, the usage areas as well as production techniques have gone through a major transformation. Industrial alcohol is distilled ethyl alcohol (C2H5OH), normally of high proof, produced and sold for other than beverage purposes. It is usually distributed in the form of pure ethyl alcohol, completely denatured alcohol, especially denatured alcohol and proprietary solvent blends. Ethyl Alcohol is the common name for the hydroxyl derivative of the hydrocarbon ethane .Industrial alcohol is distilled ethyl alcohol normally of high proof, produced and sold for other than beverage purposes. Industrial alcohol finds its applications in many chemical industries, pharmaceutical industries, Ink Industries and various allied applications. Much of this alcohol is obtained synthetically from ethylene. However, its production from microbial fermentation using variety of cheap sugary substrates is still commercially important. The various substrates used for ethanol production are sugar crops such as sugarcane, sugar beet, sorghum, etc. provide a good substrate. Bye product of these crop processing, e.g., molasses, sweet sorghum syrup, etc. are the most common substrates. Cereals like maize, wheat, rice etc are also used for ethanol production. Distillation of industrial alcohol, which is normally not used for consumption, can be made in a two step process. The process of distillation is one with a slow dynamics making it essential to have a carefully planned and designed control system. Ethyl alcohol or ethanol ranks second only to water as the most widely used solvent in chemical industry and as these industries have expanded, so the demand for industrial alcohol has increased.

Some of the fundamentals of the book are base case production of alcohol, survey and natural alcohols manufacture, alcohol from wheat straw, alcohol from sacchariferous feed stocks, conventional process used in Indian distilleries, fermentation, distillation, continuous rectification and reflux ratio, alcohol recovery, quality of alcohol, steam economy, fuel oil separation, trihydric and polyhydric alcohols, coal gasification, methanol synthesis, coal gasification and raw gas purification, synthesis gas preparation, methanol synthesis and purification, badger conceptual design
This handbook on Industrial alcohol technology provides complete details on process and the technology used in the production of ethanol from various sugar crops and cereals and also briefs the different types of monohydric, trihydric and polyhydric alcohols. This handbook will be very helpful to its readers who are just beginners in this field and will also find useful for upcoming entrepreneurs, existing industries, technical institution, etc.

1. Alcohol from Corn

Base Case Production of Alcohol, Overall Material and Energy Flows, Grain Motor Fuel Alcohol Plant, Excursions on Feedstock Material, Sensitivity to Financial Parameters, Depreciation Schedule, Purchase Price of Corn, DOG By-product, Leveraged Capital, Investment Tax Credit, Background and Job Scope, Design Basis, Base Case, Excursions, Plant Capacity, Nature of Raw Material For Process, Corn Stover (Biomass) as Primary Boiler Fuel, Corn Processing By-products, Production of Motor Fuel Grade Alcohol, Base Case, Process Description, Receiving, Storage and Milling, Mash Cooking and Saccharification, Fungal Amylase Production, Fermentation (Batch), Distillation, Fusel Oil and Heads Removal, Evaporation and Drying of Stilage Residue, Alcohol Storage and Shipping, Ammonium Sulfate Storage and Shipping, Dry Grains Storage and Shipping, Coal Fired Boiler, Water Supply, Waste Water Treatment, Flue Gas Scrubber, 100 mm Gallon per year Alcohol Plant, Fixed Investment, Excursions on Feedstock Materials, Wheat, Process Description, Milo (Grain Sorghum), Process Description, Sweet Sorghum, Process Description, Environmental Impact, Air Emissions, Waste Water, Solid Waste, Noise, Labor and Employment Impact, Agricultural Production, Plant Labour, Agricultural Impact, Subsidies and Land Use, Improved Farm Income, Grain Supply and Price, Comments on Developing Technology, Grain Production, Grain Processing, Fermentation, Distillation, Animal Feed Processing, Cellulose Alcohol Development, U.S. Army-Natick Laboratories, University of California of Berkeley (Wilke), University of Pennsylvania (Humphrey) and General Electric Company, Purdue (Tsao), Gulf Oil Chemicals Co., Development Obstacles and Research Priorities, Grain Production Improvement, Grain and Residue Collection, Grain Processing, Fermentation, Distillation, Animal Feed, Agricultural and Forest Residues, Socio-economic Development, Gasohol Subsidy, Support Adjustment, Octane Improvement and Emissions, Plant Layout, Raw Materials and Chemicals, Utilities, Plant Personnel, Products and By-products, Department of Energy Washington, D.c., Grain Motor Fuel Alcohol Plant, Investment Cost Summary, Comments on Grades of Alcohol, Cost Differential to go from 190°Proof Spirits to 199° Proof Motor Fuel Alcohol, Cost Differential Between 199° Proof Motor Fuel Alcohol and 200° Proof Industrial Anhydrous Alcohol, Evaluation Procedure for Economic Analyses, General, Annual Operating Expense, Working Capital, Parameters Affecting Financial Analyses Inflation Environment, Depreciation Schedule, Federal, State, and Local Taxes, Investment Tax Credit, Discounted Cash Flow, Methods of Obtaining Capital, Production of Grain Motor Fuel Alcohol, Alternate Capacities, 10 mm Gallon Per Year Alcohol Plant, Fixed Investment, Financial Analysis, Alcohols Polyhydric, Reactions, Manufacture, Analysis, Health and Safety Factors, Uses

2. ALCOHOLS, HIGHER ALIPHATIC

Survey and Natural Alcohols Manufacture, Detergent Range Alcohols, Plasticizer Range Alcohols, Physical Properties, Chemical Properties, Shipment and Storage, Analysis, Specifications and Standards, Toxicological Properties, Manufacture from Fats and Oils, Hydrogenolysis Process, High Pressure Hydrogenolysis, Methyl Ester Hydrogenolysis, Fatty Acid Hydrogenolysis, Production of Unsatu-rated Alcohols, Uses of Detergent Range Alcohols, Surfactants, Cosmetics and Pharmaceuticals, Lubricants and Petroleum, Other Applications, Uses of Plasticizer Range Alcohols, Plasticizers, Other Plastics Uses, Lubricants, Fuels, and Petroleum, Agricultural Chemicals, Surfactants, Other Applications, Synthetic Processes, The Ziegler Process, Triethylaluminum Preparation, Chain Growth, Oxidation, Hydrolysis, Environmental Considerations, The Oxo Process, Process Technology, Olefin Sources, The Aldol Process, The Paraffin Oxidation Process, The Guerbet Process

3. ALCOHOL FROM WHEAT STRAW

Introduction, Summary and Conclusions, Process Description, Process Discussion, Cost Estimates, Batch Process Technology in Indian Distilleries , Definitions, Molasses, Total Reducing Sugars, Unfermentable Sugars, Fermentable Sugars, Brix, Polarisation (Pol.), Purity, Alcohol, Spirit's, Wort, Pitch or Bub, Wash, Sludge, Sediment, Reflux, Spent Wash, Proof Spirit, Calculation of Efficiency Data, Alcohol Production Processes, Synthetic Process, Alcohol from Starchy Materials (Grain Spirit), Scenario, Potential of Grain as Raw Material, Process Description, Raw Material Preparation, Liquefaction, Yeast Cultivation & Prefermentation,

Saccharification & Fermentation, Alcohol from Sacchariferous Feed Stocks, Conventional Process Used in Indian Distilleries, Fermentation, Distillation, Continuous Rectification and Reflux Ratio, Alcohol Recovery, Quality of Alcohol, Steam Economy, Fusel Oil Separation, Absolute Alcohol

4. Monohydric Alcohols

Lower Saturated Acyclic (Aliphatic) Alcohols, Methyl Alcohol, Physical Properties, Chemical Properties, Ethyl Alcohol, Nonazcotropes, n-Propyl Alcohol, Isopropyl Alcohol, 1-Butanol, Isobutyl Alcohol, sec-Butyl Alcohol, Physical Properties, Chemical Properties, tert-Butyl Alcohol, Amyl Alcohols, C5H11OH, n-Amyl Alcohol, sec-Amyl Alcohol, 3-Pentanol, Active Amyl Alcohol, Isoamyl Alcohol, tert-Amyl Alcohol, Higher Saturated Acyclic (Aliphatic) Alcohols, Neopentyl Alcohol, sec-Isoamyl Alcohol, Acyclic Higher Alcohols, n-Hexyl Alcohol, Methyl Amyl Alcohol, Methyl Amyl Carbinol, 2-Ethylbutanol, n-Heptyl alcohol, 2-Heptanol, Chemical Properties and Toxicity, n-Octanol, 2-Octanol, 2-Ethylhexanol, Isooctyl Alcohol, Physical Properties, 2,2,4-Trimethyl-l-pentanol, Nonyl Alcohol, Diisobutyl-carbinol, Behenyl Alcohol, Lignoceryl Alcohol, Ceryl Alcohol, Montanyl Alcohol, Myricyl Alcohol, Melissyl Alcohol, Lacceryl Alcohol, Geddyl Alcohol, Unsaturated Acyclic (Aliphatic) Alcohols, Introduction, Health and Safety Factors, Uses, Unsaturated Alcohols, Vinyl Alcohol, Allyl Alcohol, Propargyl Alcohol, Crotyl Alcohol, Methylallyl Alcohol, Propargylcarbinol, Allylethyl Alcohol, 1-Penten-3-ol, 1-Pentyn-3-ol, Methyl Butynol, Reactions of the Hydroxyl Group , Reactions of the Triple Bond, Reactions of t tie Acetylenic Hydrogen, Reactions of the Hydroxyl Group and Triple Bond, 1-Hexen-3-ol, Leaf Alcohol, Hexynol, Methyl Pentynol, 4-Methyl-l-pentyn-3-ol, 1-Octen-3-ol, 2-Octyn-l-ol, Ethyl Octynol, Oleyl Alcohol, Citronellol, Geraniol, Linalool, Analogs and Derivatives of Alcohols, Analogs, Derivatives, Oxidation Products, Alicyclic Alcohols, Introduction, Cyclopropanol, Cyclobutanol, Cyclopentanol, Cyclohexanol, Ethynyl Cyclohexanol, Menthol, a-Terpineol, Borneol, Cholesterol, Ergosterol, Fenchyl Alcohol, Physical Properties, Chemical Properties, Araliphatic Alcohols, Benzyl Alcohol, b-Phenylethyl Alcohol, Styralyl Alcohol, Hydro-cinnamyl Alcohol, Benzhydrol, Triphenylmethanol, Cinnamyl Alcohol, Cuminyl Alcohol, Salicyl Alcohol, Phenylpropargyl Alcohol, Heterocyclic Alcohols, Furfuryl Alcohol, Tetrahydrofurfuryl Alcohol, Thenyl Alcohol, Hydroxymethylpyrrole

5. Trihydric and Polyhydric Alcohols

Trihydric Aliphatic Alcohols (Glycerols), General, Preparation, Properties, Uses, Glycerol, Occurrence, Production, Physical Properties, Grades of glycerin, Specific Gravity, Epoxy Compounds, Esters, 1,2,4-Butanetriol, Pentaglycerol, Hexaglycerol, 1,2,6-Hexanetriol, Higher Polyhydric Aliphatic Alcohols, Chemical Properties, Toxicological Properties, Uses, General, Physical Properties, Tetrahydric Alcohols (Tetritols), CH2OH(CHOH)2 CH2OH, Erythritol, d-and l-Threitol, dl-Threitol, Pentaerythritol, Pentahydric Alcohols (Pentitols), Ribitol, Xylitol, Preparation, d-Arabitol, l-Arabitol, dl-Arabitol, Hexahydric Alcohols (Hexitols), Allitol, Dulcitol, Sorbitol, Chemical Properties, Toxicity and Uses, l-Glucitol, d-Mannitol, l-Mannitol, Physical Properties, Chemical Properties, Toxicity and Uses, dl-Mannitol, d-Iditol, l-Iditol, d-Talitol, l-Talitol, dl-Talitol, Inositol, Heptahydric Alcohols (Heptitols), Perseitol, Volemitol, Glycero-gulo-Heptitol and D-glycero-D-ido-Heptitol, Octahydric Alcohols (Octitols), Polyvinyl Alcohol

6. METHANOL FROM COAL

General Discussion, Coal Gasification, Methanol Synthesis, Process Features, Dupont Feasibility Study, Preliminary Selection, Methanol Fuel Product, High Spot Process Evaluation, General Process Description, Environmental Considerations, Sasol Type Process Study, Coal Gasification and Raw Gas Purification, Synthesis Gas Preparation, Methanol Synthesis and Purification, Badger Conceptual Design, Introduction, Process Description, Economic Evaluation, Summary and Conclusions

About NIIR

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