

# final report

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# Meat handbook

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# **1** Sections

# 1.1 Section 1 Physical & chemical data

#### Conversion factors

Interactive prediction and extrapolation of tables and graphs

Needs a good section on prediction and correlation of physical factors as many parameters in the meat industry have not been measured so they need to be inferred from analysis of fat, protein, carbohydrate and moisture. Density, thermal conductivity, specific heat, Include a section on analysis of a side of meat, some cuts of meat, blood, tallow, but not a mass breakdown of a whole animal as this is better in rendering section (by-products). Prediction of COD, BOD.

# 1.2 Section 2 Meat industry statistics

Red meat production data in the world, in Australia and by major Australian companies. It will become dated but if there are website references, readers can easily update the data. The major objective is to demonstrate the size, value and importance of the industry. Benchmarking tables.

# 1.3 Section 3 On farm

Description of where the meat comes from. The effect on meat of grass vs grain feed. Feed to animal weight gain ratios. Information on animal water and energy use, and their methane/carbon dioxide production to allow cradle to grave calculations of finished meat products from farm inputs.

# 1.4 Section 4 Microbiology and Biochemistry

Microbiology is dealt with in sufficient detail to understand factory hygiene, factory cleaning needs and sanitation systems, personal hygiene and the requirements for refrigeration. Microbial growth. Pathogens and spoilage organisms, growth rate vs temperature. Odour producing organisms in anaerobic digestion. Composting organisms/process. Pasteurisation, sterilisation. Spore formers. Algae and algal blooms.

Biochemistry is dealt with to understand the changes in meat pH with stress, value of electrical stimulation, fermented meat products, blood chemistry, high value bioactives. Krebs cycle. Changes in meat with aging. Biochemical background to changes in hides in salting, blueing, curing. Blood coagulation process.

#### 1.5 Section 5 Fluid flow

Theory of laminar and turbulent flow of Newtonian and non Newtonian fluids. Design of piping systems, orifice design, economic pipe diameters, pressure drop in pipes, valves and fittings. Flow of liquids and gases are dealt with. Selection and application of compressors, blowers, and pumps. Pumping of tallow and blood. Ring main design (hot, warm and cold water and fire mains). Flow measurement

## 1.6 Section 6 Heat transfer

Heat transfer principles and problems in conduction, convection, and radiation. Conduction of heat (or cold) through sides of meat and boxes of meat and by products. Radiant heat in boiler economisers. Double skinned sterilisers. Energy balances with and without rendering systems.

## 1.7 Section 7 Humidification and Drying

This covers water cooling systems and psychometric charts, evaporative cooling, humidity, solids drying, evaporation, spray chilling, condensation problems. Changes of air in buildings.

#### 1.8 Section 8 Meat Science

Meat composition (fat, protein, bone subsections). Meat biochemistry (pre & post slaughter), protein structure. principles of muscle contraction/relaxation, rigor mortis considerations. hot vs chilled boning. tender stretching systems, force vs tenderness, meat aging, enzymes in meat, rancidity, freezing/thawing. Meat pH, Aw, Eh, electrical conductivity, the science that underpins practice

#### 1.9 Section 9 Animal processing

This large Section covers the stations from stunning to chilling. Each station needs to have numerical data where possible. Blood yield, voltage vs blood recovery, force to remove hides and skins,

#### 1.10 Section 10 Meat processing

This large section covers from carcass to the boned out animal through all the various hide on and hide off stations. Various cuts of meat. Various boning systems. Yield considerations. Traceability. Lean manufacture.

#### 1.11 Section 11 Value adding

Cutting, mincing, dicing and mixing processes. Dry mixing of powders, wet mixing and agitators. Force needed to cut/dice/slice. Salt curing (brining processes), salami making(fermentation processes). Compressive and tensile strength of meat. Meat fibre structure. Meat drying

#### 1.12 Section 12 By product processing

This is where the different rendering processes are discussed. Animal mass balance (animal on the hoof down to all the parts that make the whole). Here are gathered all the edible and non edible processing for tallow, blood meal, meat meal, tripe, liver, trachaea, sausage skins, collagen, gelatine. Sub sections on various drying systems. Blood coagulation and separators. Biodiesel manufacture. Tannery. The tanning process.

# 1.13 Section 13 Biochemical engineering

Bioactive recovery processes, high value blood fractions, pituitary glands,

## 1.14 Section 14 Novel processes

This Section can gather together all the innovation that does not fit in other Sections. Reforming meat, membrane processes

# 1.15 Section 15 Plant services

This large section has Water and treatment processes. Water mass balance Boiler and steam requirements, alternative fuels such as tallow Refrigeration and chilling /freezing processes, theory and practice. Alternative refrigeration fluids-ammonia, synthetics, CO<sub>2</sub>,

# 1.16 Section 16 Process control

Fundamentals of process control and automatic control. Sensing systems. Meat traceability systems-needs and options. RFID. Citect.

#### 1.17 Section 17 Hygiene / Cleaning

CIP systems. Chemicals used in cleaning. MSDS. Surface finish for cleanability. Clean design.

#### 1.18 Section 18 Process safety

OH&S, risk analysis, PPE, enclosed space work, hot work permits HAZOP/HAZAN HACCP

#### 1.19 Section 19 Automation

Robotics.

#### 1.20 Section 20 Materials of construction

Corrosion resistance. Metals, plastics, concrete, flooring. Economic selection

# 1.21 Section 21 Project engineering

Planned maintenance. Project management principles. Lubrication principles. PFDs and P&IDs. Conveying systems- pneumatic, hydraulic, vibrational, rollers, belts for boxes, skins, boning room byproducts.

# 1.22 Section 22 Ergonomics

#### 1.23 Section 23 Environmental management

#### Air

Air pollution and odour. Ausplume could be included.

#### Water

Water disposal including various waste treatment methods and the peculiarities of waste from abattoirs Water audits Liquid waste analyses- BOD, COD, P, N, inorganics Irrigation, conductivity, soils, SAR

#### Solid

Solids disposal including composting. Packaging waste covenant and cradle to grave considerations

#### Noise

Noise generation, management, minimisation

#### Overall

Environmental management plan, EIS, EIP Carbon balances, greenhouse gas emission, NO<sub>x</sub>

#### 1.24 Section 24 Meat industry economics

A "typical" company. Rules of thumb. Industry benchmarks. Best practice.

#### 1.25 Section 25 Process economics

Fundamentals of economic analysis. Estimating capital cost and operating cost. Return on investment and elasticity.

#### 1.26 Section 26 Electrical engineering

Basic principles of 3 phase power. Power factor and its manipulation. Electrical stimulation for blood recovery, electrical stunning, electricity use in hide pulling. Electrical audits. Minimising power use. Sizing motors. Power use measurement

# 1.27 Section 27 Change management

#### 1.28 Section 28 Analytical methods

Experimental planning, error analysis, chemical analysis, flow and temperature measurement. Metal detection, X-ray analysis, thermal imaging, ultrasonics.

#### 1.29 Section 29 Industry associations

Meat and food industry bodies and the areas they cover

#### 1.30 Section 30 Regulations

State, Federal and international regulations and specifications. Where they can be sourced.

#### 1.31 Section 31 References