ADVANCES IN SURIMI TECHNOLOGY FOR TROPICAL FISH
TROPICAL FISH SURIMI

Fish Handling:
- Wash the fish to remove dirt and foreign material
- Descaling (remove scales)
- Keep the fish at low temperature

Manual Heading & Gutting:
- Maximize Meat Recovery
- Good Removal of Guts (Enzymes)
- Wash away gut residues and blood

Meat Separation:
- Maximize meat recovery
- without carrying much skins, bones, scales

Washing the meat:
- remove blood and fat
- remove soluble protein and minerals (leaching)

Refining:
- remove residues of skins, bones, scales
- without carrying much meat with the waste

Dewatering:
- remove excess water

Mixing cryoprotectants, Freezing, Packing
TECHNOLOGY ADVANCES IN TROPICAL SURIMI PROCESSING

1 – REDUCTION OF WATER AND POWER CONSUMPTION
2 – IMPROVEMENT OF PROTEIN RECOVERY (YIELD)
3 – IMPROVEMENT OF PRODUCT QUALITY
4 – AUTOMATION OF THE SURIMI PROCESS
TROPICAL FISH SURIMI PROCESSING

WATER CONSUMPTION: 25 M3/MT SURIMI
ICE CONSUMPTION: 2-3 MT/MT SURIMI

HOW TO REDUCE WATER CONSUMPTION AND ENERGY FOR CHILLED WATER AND ICE

- Use Heat Exchanger to cool down incoming water by effluent
- Use Refrigerated Sea Water to wash raw fish and cut fish
- Design of the fish washer
- Reduce washing of the meat by using a Small Screw Press between 1st and 2nd wash
- Use CIP to clean pipes and equipments
CHILLED WATER SUPPLY WITH HEAT EXCHANGER

Energy to cool down 25 m³/h of water from 30 to 8°C: 25,000 x (30-8) = 550,000 kcal

Water Chiller (Coefficient of Performance 3):
Power: 550,000 x 4.18 / 3 = 760 kW

Heat Exchanger 100 m²:
Recovery 90% for 25 m³/h water / effluent

-> Cooling fluid = effluent at 10°C
-> Warm fluid = water at 20°C
-> Delta temperature: 30-10 = 20°C

Water Temperature Out: 30 - (30-10) x 0.9 = 12°C

Power of the water chiller Cooling from 12 to 8°C:
25,000 x (12-8) x 4.18 / 3 = 140 kW

Energy consumption for cooling water reduced by 80%

Example: cost of electricity to produce 25 m³ of chilled water for processing 1 MT surimi:
- without H.E.: 0.08 USD/kWh x 760 = 60 USD/MT
- with H.E.: 0.08 x 140 = 11 USD/MT
-> saving: 0.05 USD/kg surimi
Reduction of Energy Consumption using Sea Water to Wash Raw Fish

Recovery of Chilling Energy by Heat Exchanger
Reduction of Ice Consumption
REPLACEMENT OF 3 WASH BY 2 WASH WITH INTERMEDIATE SCREW PRESS

The intermediate press removes 70% of the “dirty water” 2 wash give similar result as traditional process with 3 wash

RESULT
Reduced water consumption, reduced chilling energy
HOW TO IMPROVE THE YIELD OF THE SURIMI PROCESS?

1 – OBSERVATION: MASS BALANCE OF THE PROCESS
   -> MEASURE THE SOLIDS THROUGH THE PROCESS: WHERE DO WE LOSE PROTEINS?

2 – IMAGINE SOME STRATEGIES TO IMPROVE MEAT RECOVERY

3 – APPLY THESE STRATEGIES:
   -> TEST IN LABORATORY AS MUCH AS POSSIBLE
   -> APPLY IN FACTORY

4 – QUANTIFY THE RESULTS

5 – TECHNOLOGY
   -> REDUCTION OF WATER/MEAT RATIO THROUGH DEWATERING OF THE MEAT BY SMALL SCREW PRESS AFTER THE FIRST ROTARY SCREEN
   -> RECOVERY OF MYOFIBRILLAR PROTEIN FROM WASTE WATER BY NYLON MESH ROTARY SCREEN
   -> USE OF WET REFINER AND DECANTER
   -> RECOVERY OF SOLUBLE PROTEIN AND SMALL MYOFIBRILLAR PROTEIN BY FLOCCULATION

6 – RESULTS
   -> IMPROVED RECOVERY FROM 28-32% TO 42-44% FOR ITOYORI SURIMI
   -> NEW TARGET = 50% RECOVERY THROUGH FLOCCULATION OF SOLUBLE PROTEIN
Fish washing: loss of 3 to 5% of the fish weight (scales, …)

Heading and Gutting: 20 to 40% “fish waste” depending on fish species

Cut Fish Washing: 2 to 3% -> avoid rotary washers with sharp surface

Meat Separator: 16 to 24% -> new design of meat separator maximize protein recovery …but compromise: avoid with excessive extraction of skin and peritoneal tissue

Washing Process: loss of 30 to 40% of protein (small myofibrillar protein, soluble protein)
-> avoid to apply shear on meat clusters (pumps …); compromise with fat removal
Reduction of water dilution and contact time results in better recovery
Myofibrillar protein recovery from waste water can represent 15% of the surimi

Refiner: loss of 2% meat together with impurities -> new technology allows 100% recovery

Screw Press: myofibrillar protein in screw-press water is easy to recover
Control of final moisture of the screw press meat can improve recovery by 5%

Ingredients: ingredients have a strong impact on recovery -> addition of ingredients should be maximized within the limits fixed by specifications (watch for processors who add more additives than specified or add non-declared additives)

Itoyori Surimi recovery may vary from 28 to 42% depending on the process and technology

Recovery of soluble protein becomes possible through new technology
Meat separation
  1st wash
  1st dewatering
  2nd wash
  2nd dewatering
  3rd wash
  3rd dewatering
  Refining
  Pressing
  Mixing

H&G Fish

Loss of myofibrillar protein in waste water

MYOFIBRILLAR PROTEIN LOST IN WASTE WATER = 20-30 %

MYOFIBRILLAR PROTEIN LOST IN REFINER = 2-3 %

Surimi
Surimi Tech Recovery Process (1)

1st washtank → 1st rotary screen → 2nd washtank → 2nd rotary screen → 3rd washtank → 3rd rotary screen → Refiner → Screw Press → Mixing High Kneader → Block Former

Defatting tank → 1st recovery screen → Defatting tank → 2nd recovery screen

Wet refiner → Mixing tank

Water

Surimi : 80-85% Primary Grade

Surimi : 15-20% Second Grade

H&G fish

Block Former

Small Screw-Press

Mixing High Kneader
Surimi Tech Recovery Process (2)

1. **Meat separation**
2. **1st wash tank**
3. **1st rotary screen**
4. **2nd wash tank**
5. **2nd rotary screen**
6. **3rd wash tank**
7. **3rd rotary screen**
8. **Refiner**
9. **Screw Press**
10. **Mixing High Kneader**
11. **Block Forming**

**Flowchart:**
- **H&G fish**
- **Defatting tank**
- **1st recovery screen**
- **Defatting tank**
- **2nd recovery screen**
- **wet refiner**
- **Decanter**
- **Mixing High Kneader**
- **Block Forming**

**Surimi Grades:**
- **Surimi: 75-85% Primary Grade**
- **Surimi: 15-25% Secondary Grade**
Surimi Process with 2 wash and intermediate dewatering by small screw press

When soaked into water, fresh fish meat absorbs 1 to 1.5 times its own weight of water. This water is dirty water containing blood and enzymes transferred with the meat to second wash tank. Every washing step results in a loss of 10 to 15% of the protein.

Adding a small screw-press between first rotary screen and second wash tank, allows to remove 70-75% of the water carried by the meat to the second wash tank:

Meat separator -> 1 MT Fish Meat (80% moisture, 20% dry solids) -> add 4 m³ water in 1st wash tank
-> 1st rotary screen : 2.5 MT meat (92% moisture + 8% dry solids) + 2.5 m³ waste water (8% wet solids)
-> small screw-press : 1100 kg meat (85% moisture, 15% dry solids) + 1400 l waste water (10% wet solids)
-> second wash tank : 1100 kg meat + 2500 l water
-> second rotary screen -> refiner -> screw-press -> mixing -> packing

As a result, while reducing the water consumption by 25-30% and improving protein recovery by 3-5% the final product has less contamination from the first waste water (enzymes/blood) than in a 3 wash process.
The decanter is used to maximize meat recovery from refiner waste and increase productivity.
FACTORY DESIGN

RECEIVING AND CUTTING AREA THAT ALLOWS EASY SORTING, FAST WASHING AND COOLING OF THE FISH, CONTROL OF THE PERFORMANCE OF THE CUTTING WORKERS, QUICK WASHING AND COOLING OF THE CUT FISH, MINIMIZE CIRCULATION OF WORKERS AND GUARANTEE MOVING FORWARD OF THE PRODUCT WITHOUT CROSSING OVER
MACHINERY

Nylon Mesh
Recovery Screen

Wet Refiner

Surimi Decanter
IMPROVEMENT OF THE PRODUCT QUALITY

• CONTROL THE WASH RATIO
• REDUCTION OF THE REFINER SPEED

• SEPARATION OF HIGH QUALITY MEAT FROM FIRST SECTIONS OF THE REFINER
  PRODUCTION OF A SECOND GRADE FROM LAST 2 SECTIONS OF THE REFINER

• USE OF WET REFINER TO CLEAN THE REFINER WASTE: ALLOWS 100% MEAT
  RECOVERY WHILE MAXIMIZING THE QUALITY OF MAIN LINE PRODUCT

• MINIMIZE THE USE OF PUMPS: USE GRAVITY TO CIRCULATE WATER AND MEAT
• CONTROL OF THE PRODUCT MOISTURE BY USING 2 SCREW-PRESSES IN SERIES
In order to reduce the loss of meat in refiner, most factories are running the refiner at high speed (too fast) -> this results in loss of GS by 100-200 points, reduced whiteness by 0.5-2 points, increased impurities by 50%. A quick diagnosis can be done by checking refiner meat temperature at the different sections and by the appearance of the meat coming out last section of refiner: if temperature of the meat from section 1 to 4 increases over 5°C and meat coming out section 4 looks like instant noodle, the refiner is running too fast. -> Recommended speed of refiner for best surimi quality: 600 to 700 RPM
DOUBLE SCREW PRESS FOR DEWATERING

• First Screw Press: Small Screw-Press L2.5m Ø 400 dewater the meat from 90-92% to 86%
• Second Screw Press: Big Screw-Press L6m Ø 600 dewater the meat from 86% to 82%
  • Easy control of dewatering: product output does not depend on the speed of the screw-press
  • Higher output / productivity for minimum investment
PROCESS CONTROL AND AUTOMATION

FACTORY DESIGN FOR EASY MONITORING OF THE PROCESS

CENTRAL CONTROL POINT: The production manager has total control on 2 processing lines and manages the process by inverters.
THANK YOU

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