



# *SOMETHING FISHY IS IN THE AIR*

STEPHANIE R. CARTER, PHD, CIH

IWORKWISE

CIHC, 2025

LONG BEACH, CA

# INTRODUCTION TO SEAFOOD INDUSTRY (ALASKA)

- SEAFOOD TYPES

- SHELLFISH

- CRAB, SCALLOP, ETC.



- BONY FISH

- SALMON
    - HALIBUT
    - COD
    - POLLOCK/HAKE

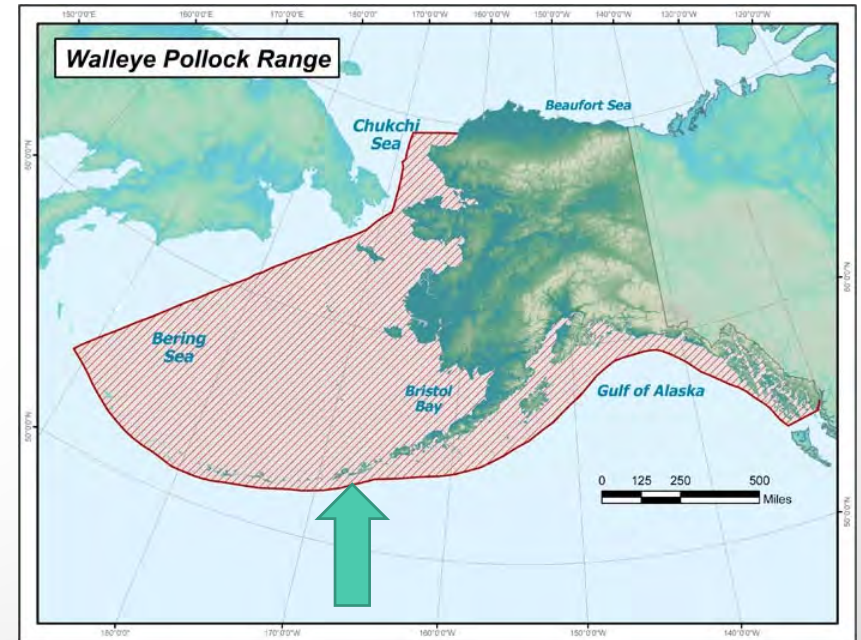


- BONY FISH PRODUCTS

- H&G
    - FILLETS
    - CANNING
    - MINCE (FISH STICKS)
    - SURIMI (IMITATION CRAB)
    - FISH MEAL
    - FISH OIL
    - ROE/MILT

<https://www.fisheries.noaa.gov/species/>

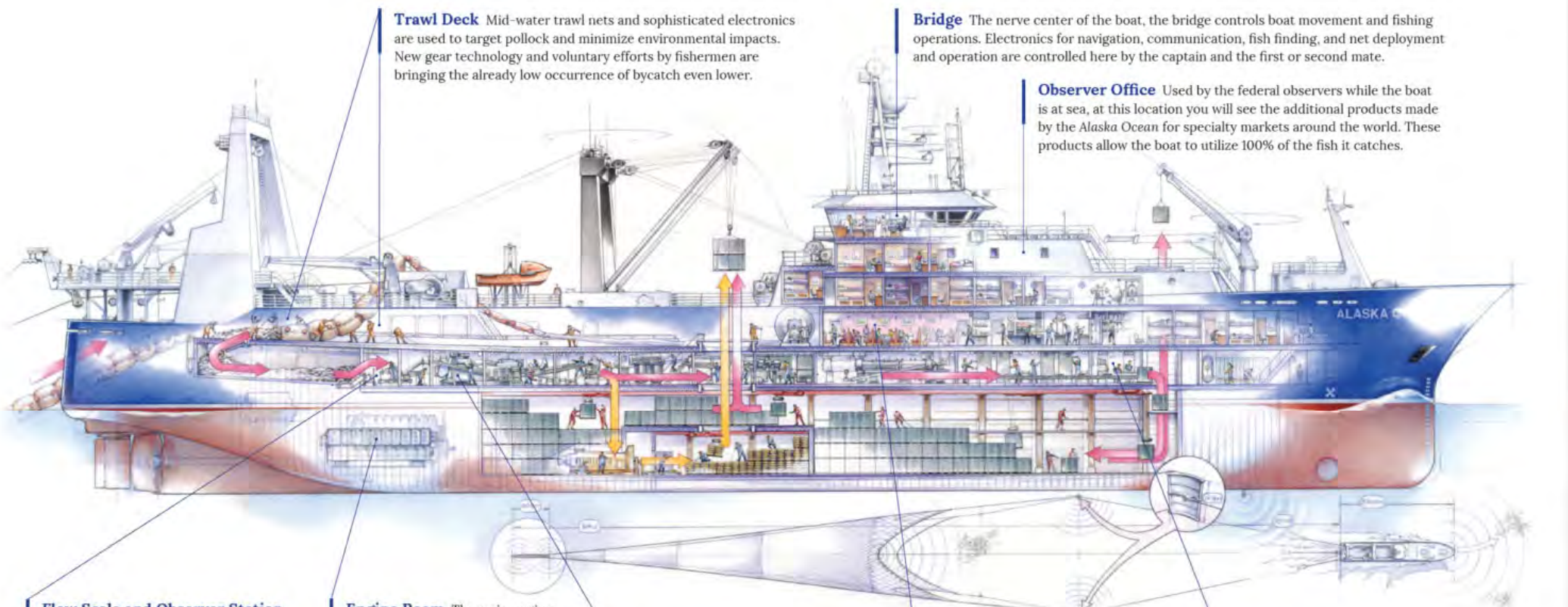
# UNALASKA, ALASKA “DUTCH HARBOR”



<http://www.adfg.alaska.gov/index.cfm?adfg=walleyepollock.rangemap>



<https://www.ci.unalaska.ak.us/community/page/story-name-unalaska-or-dutch-harbor>



**Trawl Deck** Mid-water trawl nets and sophisticated electronics are used to target pollock and minimize environmental impacts. New gear technology and voluntary efforts by fishermen are bringing the already low occurrence of bycatch even lower.

**Bridge** The nerve center of the boat, the bridge controls boat movement and fishing operations. Electronics for navigation, communication, fish finding, and net deployment and operation are controlled here by the captain and the first or second mate.

**Observer Office** Used by the federal observers while the boat is at sea, at this location you will see the additional products made by the *Alaska Ocean* for specialty markets around the world. These products allow the boat to utilize 100% of the fish it catches.

**Flow Scale and Observer Station**

All harvested fish are weighed onboard the vessel. The catch of Alaska pollock and any incidental catch of non-target species is documented by federal observers to ensure that the total catch adheres to scientifically set quota levels. Observers also conduct catch sampling to supplement other fishery research used to set the quota each year.

**Engine Room** The main engine produces 6600 horsepower for propulsion, and three auxiliary engines produce 1500 kW of electricity for operation of all other vessel systems. The *Alaska Ocean* is the only vessel in North America with a CO<sub>2</sub> refrigeration system—the most environmentally friendly system in use today.

**Fillet and Surimi Production** Fish are sorted by size to increase recovery and then filleted at an average rate of 180 fish per minute. Fillets and surimi are processed and frozen in less than 12 hours from harvest.

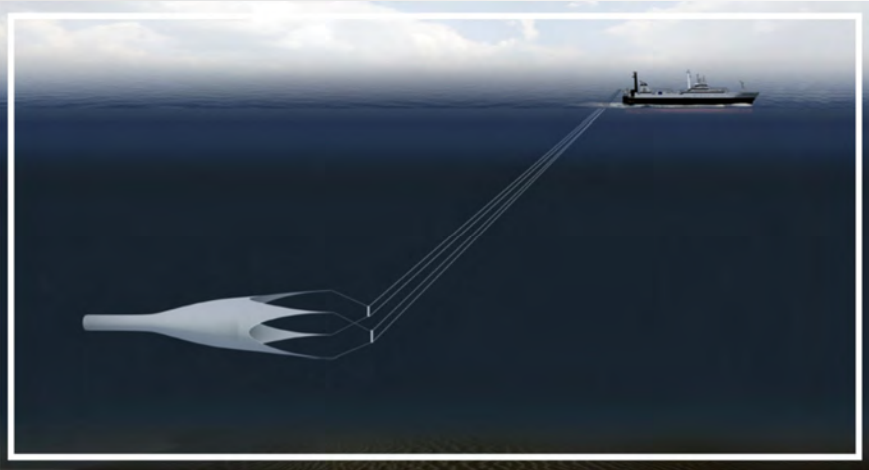
**Galley and Staterooms** For the 141 people on board, this is home during their time at sea. Rooms, meals, medical services, laundry service, crew lounge, workout area, and email access are provided.

**Case-Up Area** After freezing, products go through a final inspection before packaging. The production code on each package allows for traceability back to the date and vessel location at the time of harvest.



# POLLOCK FISHING

- VESSELS
  - TRAWLER
  - CATCHER-PROCESSOR

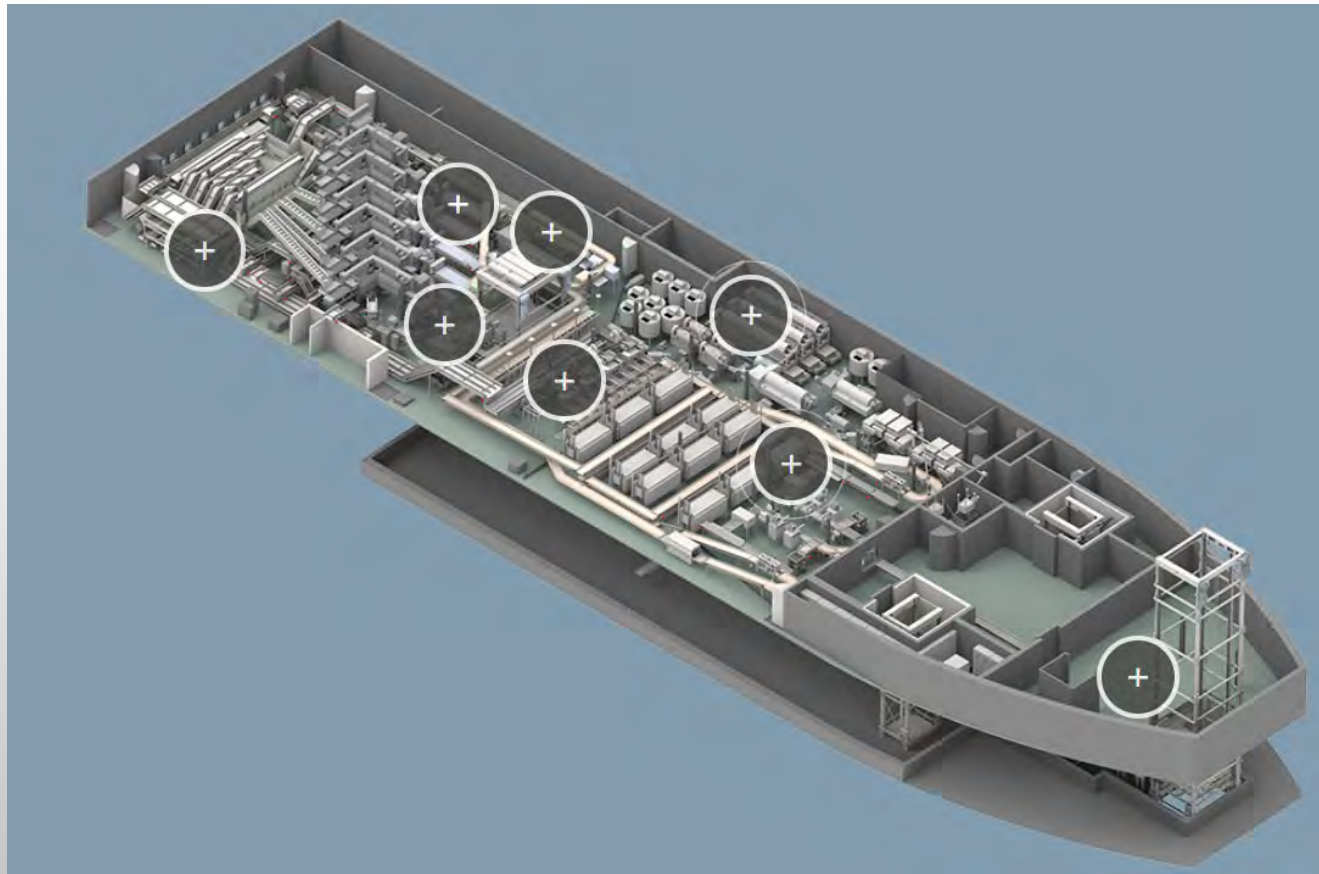


<https://www.youtube.com/watch?v=U3FZ-yY6xGk>

[https://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view\\_article&articles\\_id=141](https://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view_article&articles_id=141)

## PROCESSING OVERVIEW

- SORTING
- FILLETING, ETC.
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL
- ROE/MILT



## POLLOCK PROCESSING EQUIPMENT/JOBS

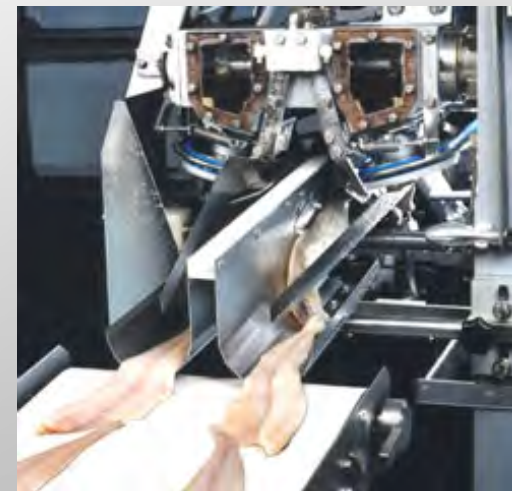
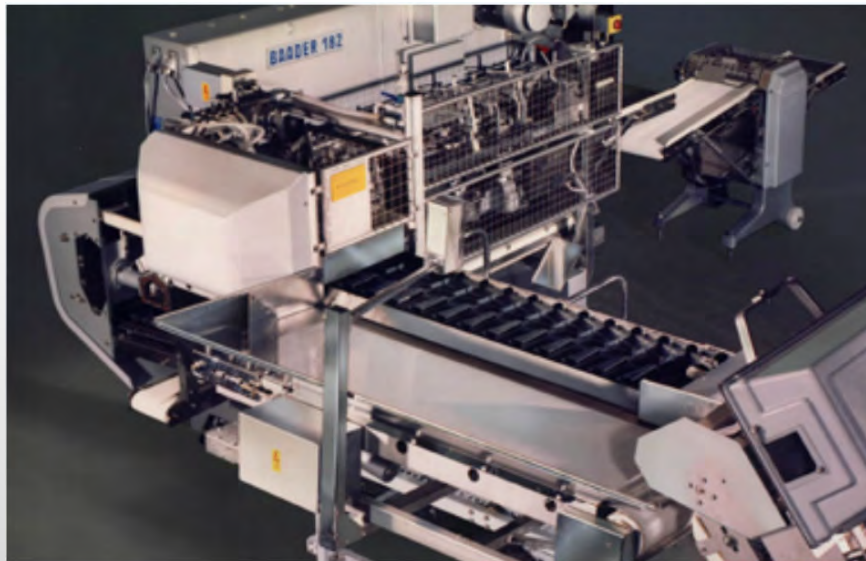
- **SORTING**
- FILLETING
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL
- ROE/MILT



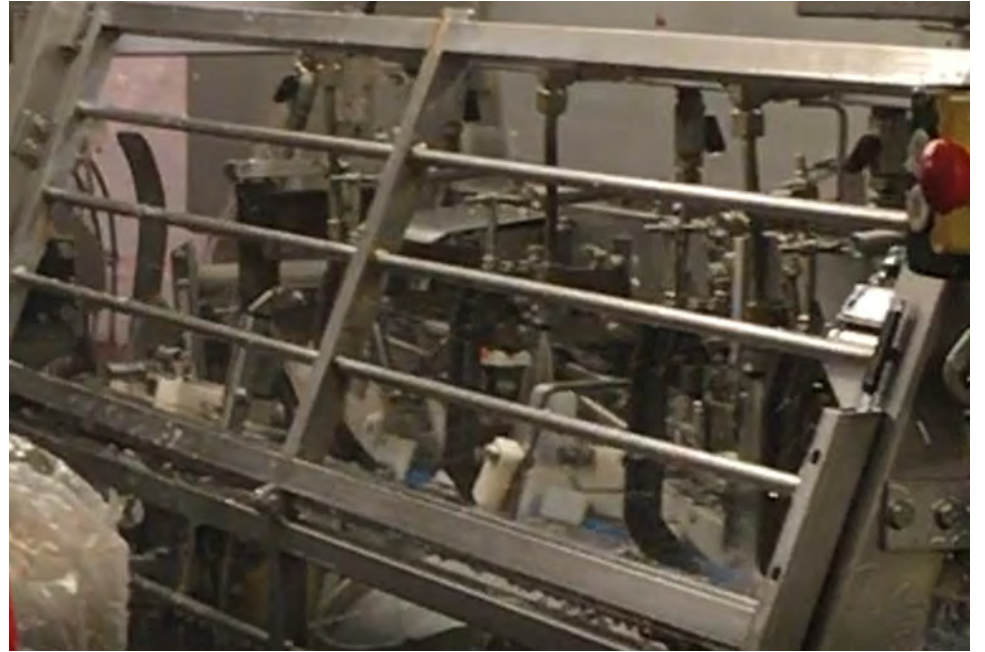
<https://carsoe.com/seafood-processing/pollock-surimi/>

# POLLOCK PROCESSING EQUIPMENT/JOB

- SORTING
- **FILLETING**
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL
- ROE/MILT

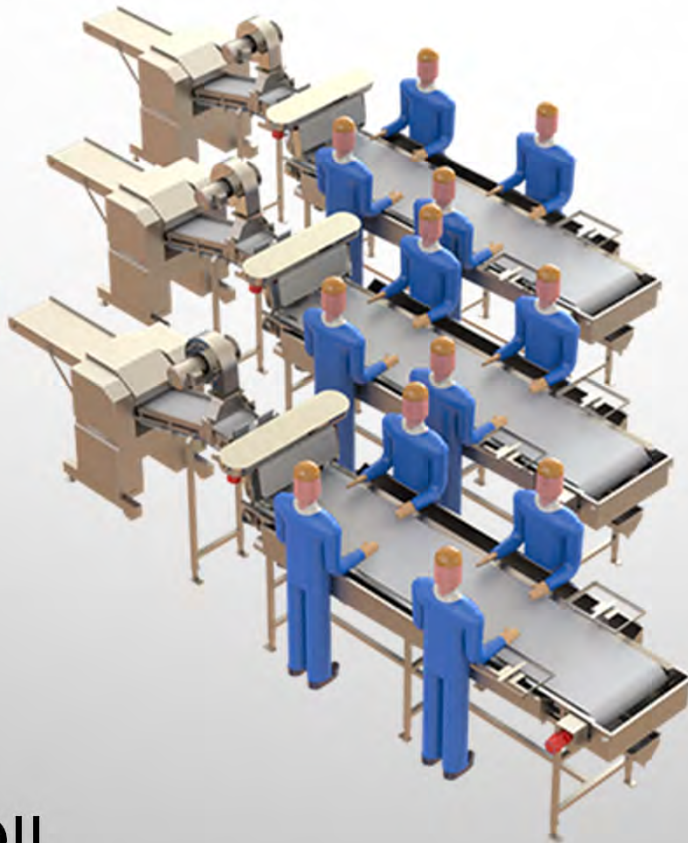


[https://www.baader.com/en/products/fish\\_processing/whitefish/saithe/filleting.html](https://www.baader.com/en/products/fish_processing/whitefish/saithe/filleting.html)



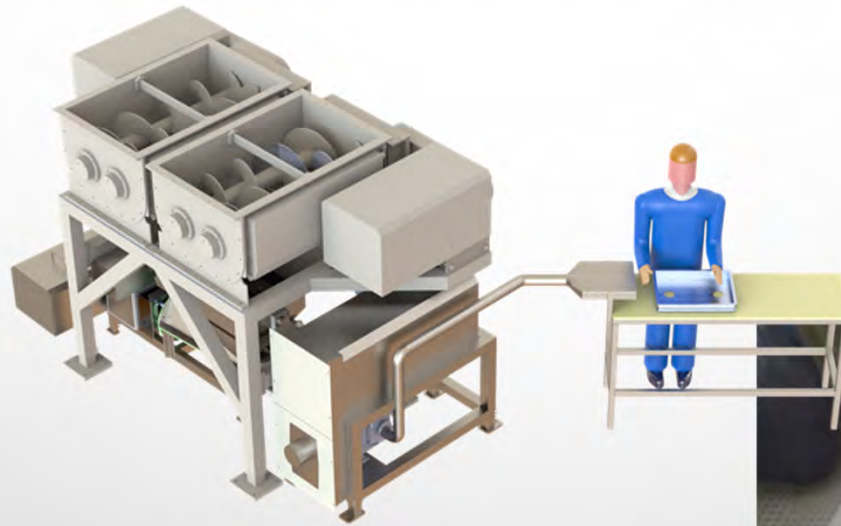
## POLLOCK PROCESSING EQUIPMENT/JOBS

- SORTING
- FILLETING
- **INSPECTION**
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL



# POLLOCK PROCESSING EQUIPMENT/JOBS

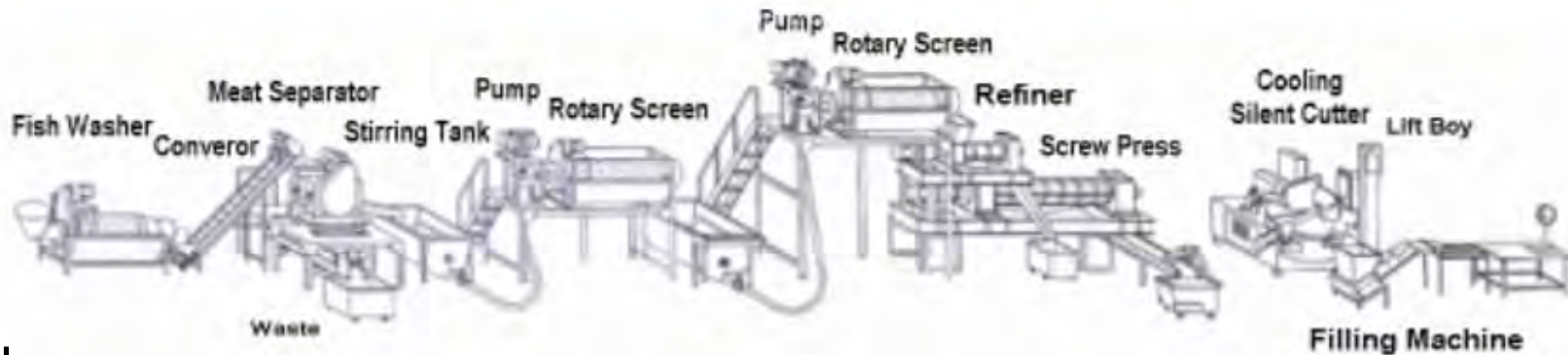
- SORTING
- FILLETING
- INSPECTION
- **MINCE**
- SURIMI
- FREEZING
- FISH MEAL/OIL
- ROE/MILT
- PACKING/STORAGE



# POLLOCK PROCESSING EQUIPMENT/JOBS

- SORTING
- FILLETING
- INSPECTION
- MINCE
- **SURIMI**
- FREEZING
- FISH MEAL/OIL
- ROE/MILT
- PACKING/STORAGE

Fish Washing	Fish Meat Extracting	1st Bleaching	Draining & Bleaching	2nd Bleaching	Draining & Bleaching	Straining	Dehydrating	Mixing & Adding	Packing
Fish Washer	Meat Separator	Sterring Tank	Rotary Screen	Sterring Tank	Rotary Screen	Refiner	Screw Press	Cooling Silent Cutter	Surimi Filling & Forming Machine



<http://www.ube-yanagiya.com/html/products/surimi%20products/surimi-plant.html>

# POLLOCK PROCESSING EQUIPMENT/JOBS

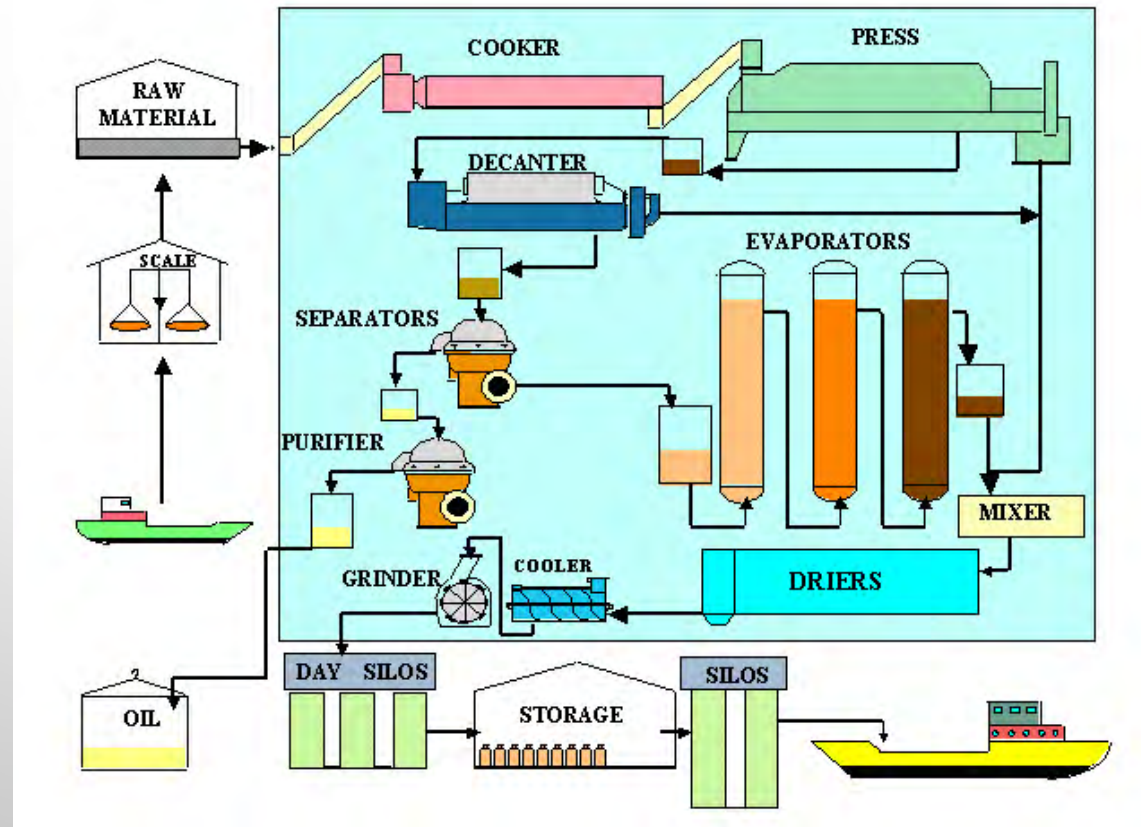
- SORTING
- FILLETING
- INSPECTION
- MINCE
- SURIMI
- **FREEZING**
- FISH MEAL/OIL
- ROE/MILT
- PACKING/STORAGE



<https://dsifreezing.com/horizontal-plate-freezers/horizontal-freezer/>

# POLLOCK PROCESSING EQUIPMENT/JOBS

- SORTING
- FILLETING
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- **FISH MEAL/OIL**



# POLLOCK PROCESSING EQUIPMENT/JOBS

- SORTING
- FILLETING
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL
- **ROE/MILT**
- PACKING/STORAGE



# POLLOCK PROCESSING EQUIPMENT/JOBS

- SORTING
- FILLETING
- INSPECTION
- MINCE
- SURIMI
- FREEZING
- FISH MEAL/OIL
- ROE/MILT
- **PACKING/STORAGE**



# HEALTH EFFECTS FROM SEAFOOD

- IMMUNOLOGICAL IGE-MEDIATED
  - SENSITIZATION
  - ASTHMA
    - 4%-36% FOR SHELLFISH
    - 2%-8% FOR BONY FISH
  - INHALATION OR VIA DISRUPTED SKIN BARRIER
- INFECTIONS/FLU/COLDS
- NON-IMMUNOLOGICAL
  - RESPIRATORY IRRITATION
  - DERMATITIS
  - PARASITES
    - ANISAKIS
  - TOXINS
    - CIGUATERA
    - MARINE BIOTOXIN
    - SCROMBOID POISONING
    - PUFFER FISH POISONING

Common to have flu/cold transmission on-board due to wide geographic distribution of arriving workers

*Bohlokke, et al (2019); Jeebhay, et al (2019); Jeebhay (2001)*

# HEALTH EFFECTS FROM SEAFOOD

- HIGH-MOLECULAR WEIGHT ALLERGENS
  - TROPOMYOSIN
    - MOLLUSKS
      - GASTROPODS (ABALONE), BIVALVES (CLAMS, OYSTER, MUSSEL), CEPHALOPODS (SQUID, OCTOPUS)
    - ARTHROPODS
      - CRUSTACEAN (CRAB, LOBSTER, PRAWN, SHRIMP)
  - PARVALBUMIN
    - CHORDATES/BONY FISH (COD, SALMON, TUNA, HERRING, SARDINE, MACKEREL, CARP, POLLOCK, HAKE)
- PROTEOLYTIC ENZYMES
  - TRYPSIN – POTENTIAL TO INCREASE AIRWAY INFLAMMATION
- OTHER CONTAMINANTS
  - ENDOTOXINS – MOST LIKELY RELATED TO ACUTE SYMPTOMS
  - TOTAL PROTEIN LEVELS
  - WHITEFISH SLIME/SKIN
  - OUTER SHELLS OF CRUSTACEANS

*Bohlokke, et al (2019); Jeebhay, et al (2019); Jeebhay (2001)*

# TALE OF TWO TRIPS



# EXPOSURE ASSESSMENT

## ○ IEQ/IAQ

- CARBON DIOXIDE (CO<sub>2</sub>)
- HUMIDITY/TEMPERATURE
- CARBON MONOXIDE (CO)
- VENTILATION

## ○ RESULTS

- CO<sub>2</sub> AND CFM MEET GUIDELINES
  - IMC, 403.3 (10/1000 FT<sup>2</sup>, 15 CFM/PERSON)
- CARBON MONOXIDE DRI
  - 8 PPM – FACTORY ONSHORE
  - UP TO 75 PPM - PROCESSING

### ▪ Hypochlorite generation (1%)

- Sea water electrolysis



# EXPOSURE ASSESSMENT – GAS/VAPOR

## ○ CLEANING/SANITIZING

- SODIUM HYPOCHLORITE,  
POTASSIUM HYDROXIDE



- OZONE GENERATORS



## ○ REFRIGERATION

- AMMONIA
- FREON
- CO<sub>2</sub>

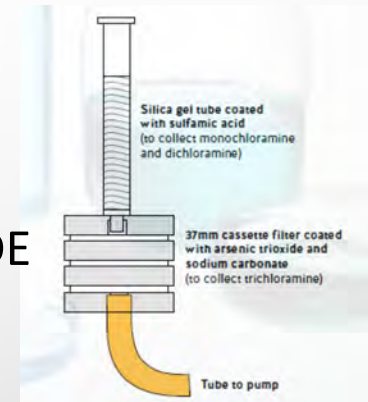


## ▪ MID/END OF TRIP

- HYPOCHLOROUS ACID
- NITROGEN TRICHLORIDE
- CHLORINE GAS (DRI)

## ▪ OZONE DRI

## ▪ DRI/ALARMS/INTERLOCKS



# EXPOSURE ASSESSMENT – PARTICULATE MATTER

- PARTICULATE MATTER

- INHALABLE
- RESPIRABLE

- PARVALBUMIN

- THORACIC OR INHALABLE
  - ELISA ANTIBODY ASSAY (BASED ON COD OR POLLOCK)

- PARTICULATE ID

- PARTICULATE SIZE FRACTIONS DRI



# PARTICULATE (AND NOISE) RESULTS

- RESULTS

- SPORE TRAP AIR SAMPLES (FACTORY)

- NO TO FEW SPORES, NO POLLEN
    - ANIMAL FAT CELLS, SALT, SOOT, DIESEL EXHAUST

- SURFACE/TAPE SAMPLES

- ANIMAL FAT CELLS, SOOT

- PARTICLE SIZE DRI

- SORTING TO FILLET: >2.5 MICRON
    - MINCE TO FREEZING: < 2.5 MICRON

- NOISE

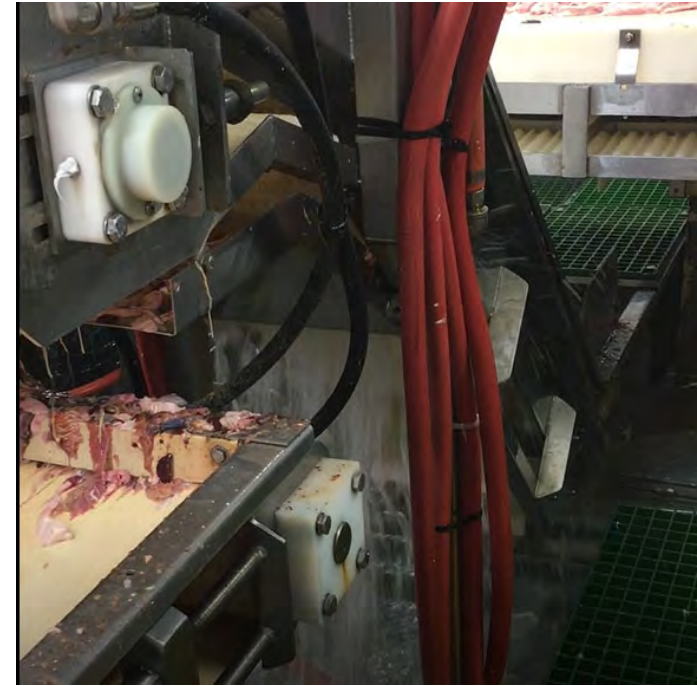
- WORK

- SORTING TO FILLET: 90 TO 95 DBA
    - SURIMI: 95 TO 100 DBA
    - FREEZING/PACKAGING: 85 – 90 DBA
      - PAN NOISE
    - FISH MEAL: 95 – 100 DBA
    - ENGINE ROOM: > 100 DBA

- OFF-SHIFT (24-HOUR EXPOSURE)

- CONTRIBUTE LITTLE TO NOISE EXPOSURE

*Neitzel (2006), <https://pubmed.ncbi.nlm.nih.gov/16732555/>*



## PARTICULATE MATTER RESULTS

- SUGAR ROOM
- WATER SPRAY
  - PROCESS WATER
  - CLEANING TASKS
- STAGNANT MIST



# EXPOSURE ASSESSMENT CONSIDERATIONS

## ■ UNUSUAL WORK SCHEDULES

- LONG SHIFTS (12 - 16 HRS)
- EXTENDED TRIPS (8-14 DAYS)
  - CAN BE LOTS OF DOWNTIME
    - FINDING THE FISH, WEATHER
- OEL ADJUSTMENT FOR PM
  - 41% - 56%

Guide for the adjustment of permissible exposure values (PEVs) for unusual work schedules



4<sup>th</sup> edition revised and updated

## • SAMPLING ISSUES

- LOTS OF WATER AND FISH SCALES
  - ZIP-LOCK BAGS, PLASTIC BELTS
- FOOD QUALITY CONCERNS
  - BELTS, SAMPLER AND CLIPS (TAPE)
  - GLASS TUBES- COVER WITH TYGON TUBING
- SAMPLE TRANSPORT/ICE
  - GALLEY FREEZER/FREEZER HOLD
  - DUTCH HARBOR, AK TO ANCHORAGE, AK TO SEATTLE, WA TO HSE IN BUXTON, UK

# EXPOSURE CONTROLS

- REDUCE WATER SPRAY
  - PROCESSING
    - DRAIN EXTENSIONS
    - REDUCE PRESSURE
    - SCREENS
  - CLEANING
    - BULK REMOVAL 1<sup>ST</sup>
    - LOW PRESSURE RINSE





## EXPOSURE CONTROLS

- ISOLATION
  - SCREENS/CURTAINS
  - PLASTIC SHEETING
  - ENGINEERED/MACHINE



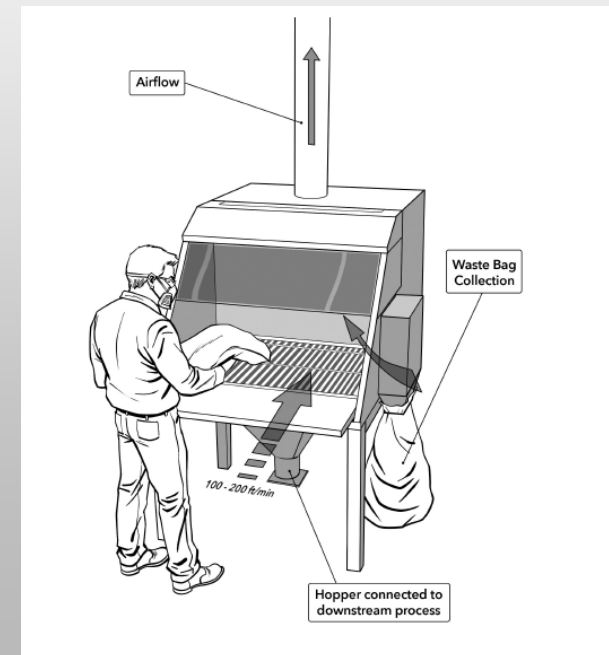
# EXPOSURE CONTROLS



- DILUTION VENTILATION
  - DIRECTION
  - TEMPERATURE



- LOCAL EXHAUST VENTILATION
  - LITTLE HEAD SPACE
  - SUGAR ROOM



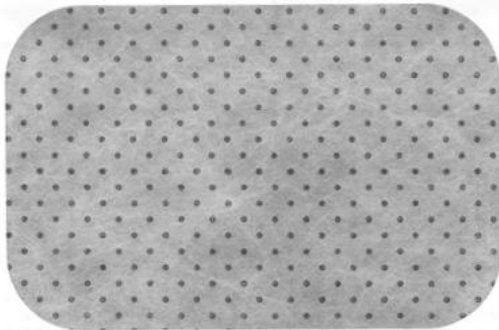
<https://www.cdc.gov/niosh/docs/2018-122/pdfs/2018-1>

# EXPOSURE CONTROLS

- RESPIRATORY PROTECTION
  - N95 FFR
  - 1/2 FACE ELASTOMERIC
  - PAPR



<https://cleanspacetechnology.com/healthusa/>



<https://readimask.com/>



# LAGNAIPPE

- MAILING VS. FLYING WITH SAMPLING EQUIPMENT
  - MAIL, SEND WITH SHIP AHEAD OF TIME (WEEKS), OR RISK LOSING DURING FLIGHT
- SAMPLE HANDLING ON SHIP OR BACK HOME
  - HIGHER BLANKS ON IOM FOR PARVALBUMIN WITH ON-BOARD PROCESSING
  - WALL DEPOSITS
- DRAMAMINE/SCOLPAMINE
  - EYE MUSCLE RELAXATION
  - BIFOCAL/MAGNIFIED SAFETY GLASSES
- ODOR

# PEOPLE AND THEIR HEALTH EFFECTS

- EXAMPLES

- NEW EMPLOYEES QUICKLY IDENTIFIED AS HAVING SENSITIVITY/SYMPTOMS
  - MUTUAL PARTING OF WAYS
- LONG TERM, INVESTED EMPLOYEES WITH SENSITIVITY/SYMPTOMS
  - MANAGE WITH MEDICATION
  - RESPIRATORY PROTECTION
  - JOB CHANGE
- IDIOPATHIC PULMONARY FIBROSIS

# POLLOCK FISHING

