# Protein Hydrolyzates from Fish

GEA process solutions

engineering for
a better world

gea.com

# Nature utilizes everything – so can you

**From sea to plate**
We supply single units and complete production lines for preparation, marination, processing, slicing and packaging of fresh and frozen fish and seafood.

**Protein powder**
Protein powder is one of the most valuable substances which can be obtained from fish by-products. With GEA, you have a partner to assist in the complete process.

With GEA, you have the right partner for processing everything from the fish, from filets to heads, skins, entrails, bones and tails, through to the process water.

There is more to a fish than a filet. In salmon, for example, the filet is 65 – 73 percent of the fish. The remainder can be processed into valuable oil and protein for pet food, cosmetics or human consumption. With expertise from GEA, you can maximize the added value of the whole fish.

**Fish oil**
GEA also offers complete process lines to process by-products into fish oil and meal. From preparation, mincing and cooking up to the required centrifugal separation technology.

**Sustainability**
During fish processing, several waste streams are produced. GEA offers sustainable treatment solutions to recover valuable constituents and minimize water consumption as well as disposal costs.

# GEA engineering solutions – smart, transparent, fair

In general, the quality of a protein is determined by its protein and fat content, odor, color and water solubility. These properties are influenced by the quality and composition of the raw material, as well as its handling and processing.

Desired protein quality is only one side of the coin though when it comes to making decisions about investments in your processing plants. Complexity and costs are the other side. The purer the protein required, the more separation stages you need in your process. Also, the design of the cleaning-in-place process has to be taken into account.

The trick is to design the process in a way that perfectly balances all those different aspects so that every customer ends up with their individual perfect solution.

Due to our extensive know how in designing, building and optimizing complete fish processing plants, we are able to offer different process setups with the necessary hygienic design.

Depending on functionality, solubility, fat content, raw material quality and hygienic processing, the protein fraction offers many opportunities for fish processors to add value to their product.

## THESE SETUPS DISTINGUISH THEMSELVES IN PROTEIN QUALITY AND PROCESS COMPLEXITY:

These three options are engineered in such a smart way that you can easily upgrade your process from our basic HFP (hydrolyzed fish protein) solution via plus to prime.

For starters, we recommend our HFP setup which results in a hydrolyzed protein with a higher value than fish meal. Here, the protein functionalities are good, investment and installation efforts are limited.

For improved protein qualities and functionalities we can offer you our HFP plus process setup

If you would like to opt for maximum quality and functionalities our HFP prime solution is your first choice.

| | HFP | HFP plus | HFP prime |
|---|---|---|---|
| Yield* protein phase | high | high | medium |
| Fat content | 5 – 10 | medium | < 1 |
| Protein content | 75 – 80 % | 80 – 85 % | > 90 % |
| Ash/salt content | high/high | medium/high | low/low |
| Value | low | medium | high |

*based on processed raw material*

# For starters – HFP

## High yields and protein contents of up to 80 percent

Prior to enzymatic treatment, the fish by-products have to be ground. For this preparation stage, GEA offers the GEA PowerGrind. These hole plate grinders very efficiently, but also gently, grind the by-products to the required particle size. They are designed for sanitary processing and daily cleaning, are DGUV certified and can handle both frozen and semi-frozen blocks. For small capacities, we also have mincers in our portfolio.

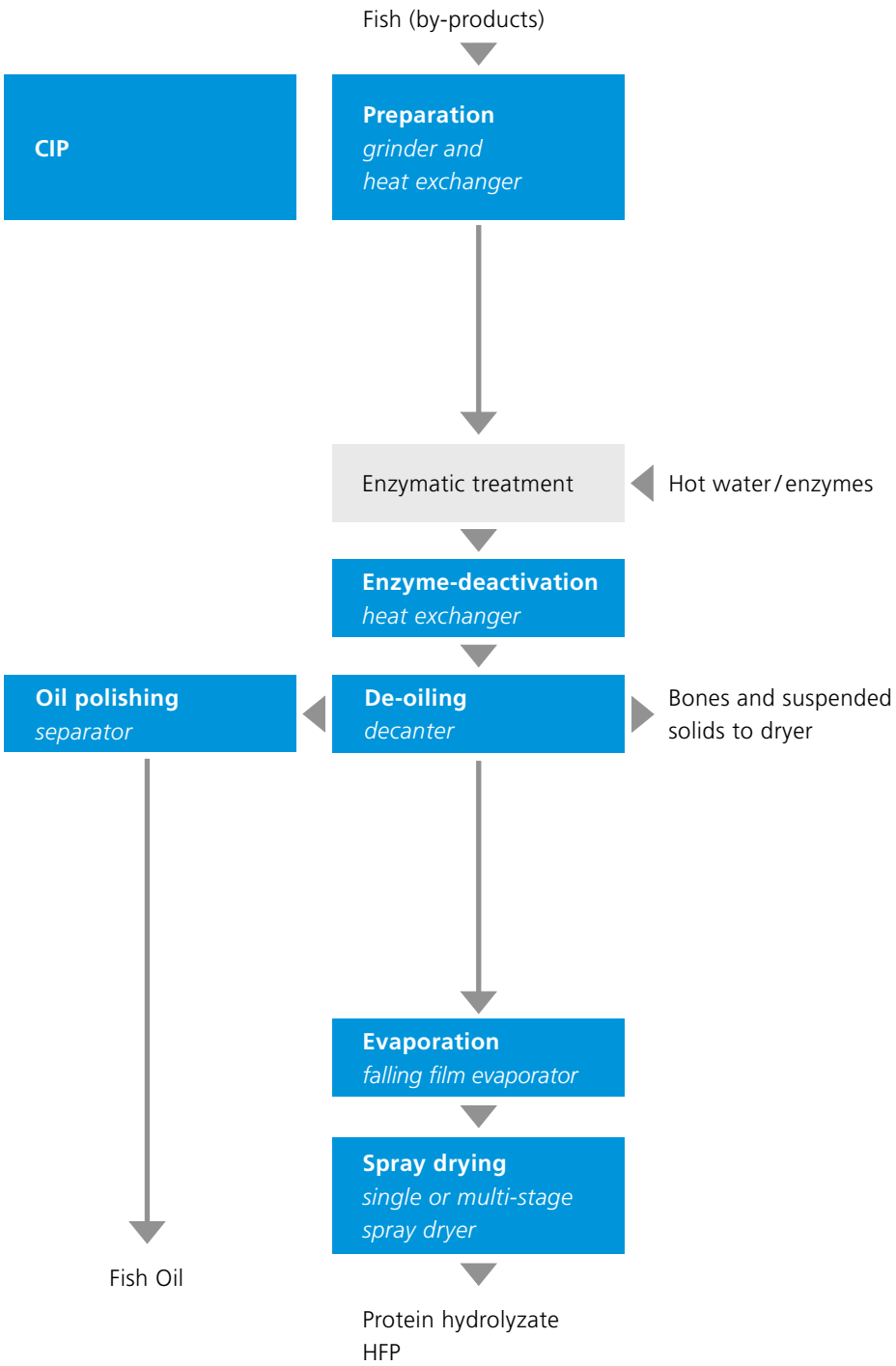
After enzymatic treatment and deactivation, the solids have to be separated. For this purpose, GEA offers decanters in 2- and 3-phase design. 3-phase decanters separate the solution into fish oil, protein and solids (bones and suspended solids). For maximum added value of your process, the fish oil from the decanter is being polished. Solids can be further processed to fishmeal with the help of a disc drier.

The protein phase from the decanter is sent to evaporation. Our evaporators provide gentle evaporation with boiling temperatures of only 50 – 60 °C. The result is excellent protein quality. Integrated heating concepts will minimize your energy consumption.

GEA offers a wide range of single- and multi-stage spray dryers for protein drying. GEA spray dryers can be configured to accommodate a broad spectrum of powder properties, like particle size and density. GEA's FSD® is a multi-stage unit that combines spray drying and fluid bed technology in one plant. This solution is ideal if you need a high level of flexibility to make powders with different levels of agglomeration, lecithination and particle size. The FSD® generates uniform, coarse, free-flowing and dustless particles and powders with excellent dispersibility. Whereas a single stage spray dryer generates a finer powder with a higher bulk density.

Our HFP process offers reasonable protein quality and functionality for a reasonable investment and installation effort.

## High fat hydrolyzate (75 – 80 % protein content)



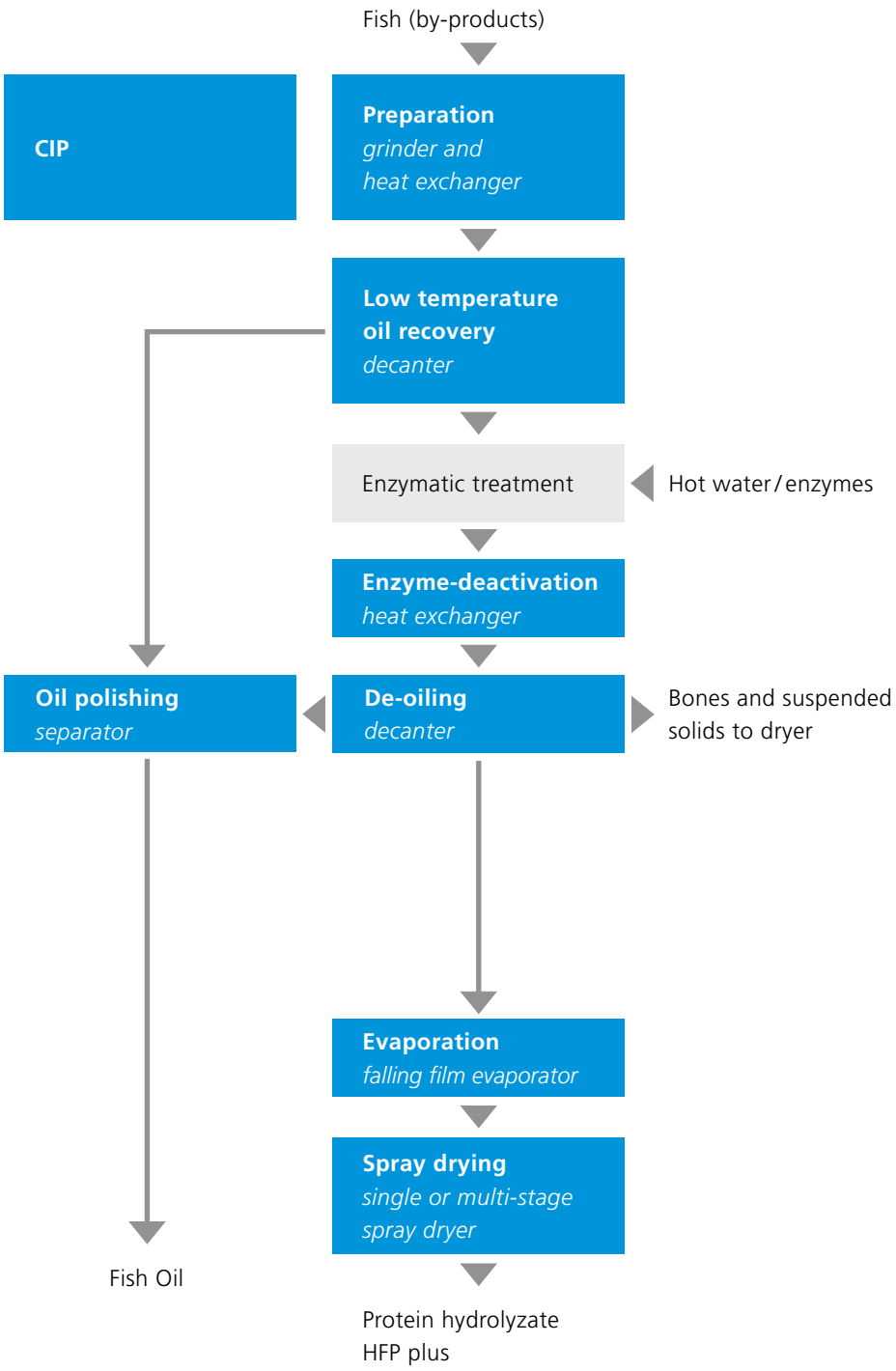
# For a high value protein – HFP plus

Protein contents of up to 85 percent and less than five percent fat content

The difference between the former and this HFP plus option is the low temperature deoiling between preparation and enzymatic treatment. A 3-phase decanter separates the oil phase from the water and solids in an early stage at low temperatures. This not only improves the quality of your protein due to the lower fat content, it also improves the quality of the obtained fish oil. This is because the lower temperature results in a brighter oil colour, lower free fatty acids and lower anisidine and peroxide residues.

Our HFP plus process results in high value protein with a lower fat content and a better fish oil quality compared to HFP.

## < 5 % fat hydrolyzate (medium protein quality)



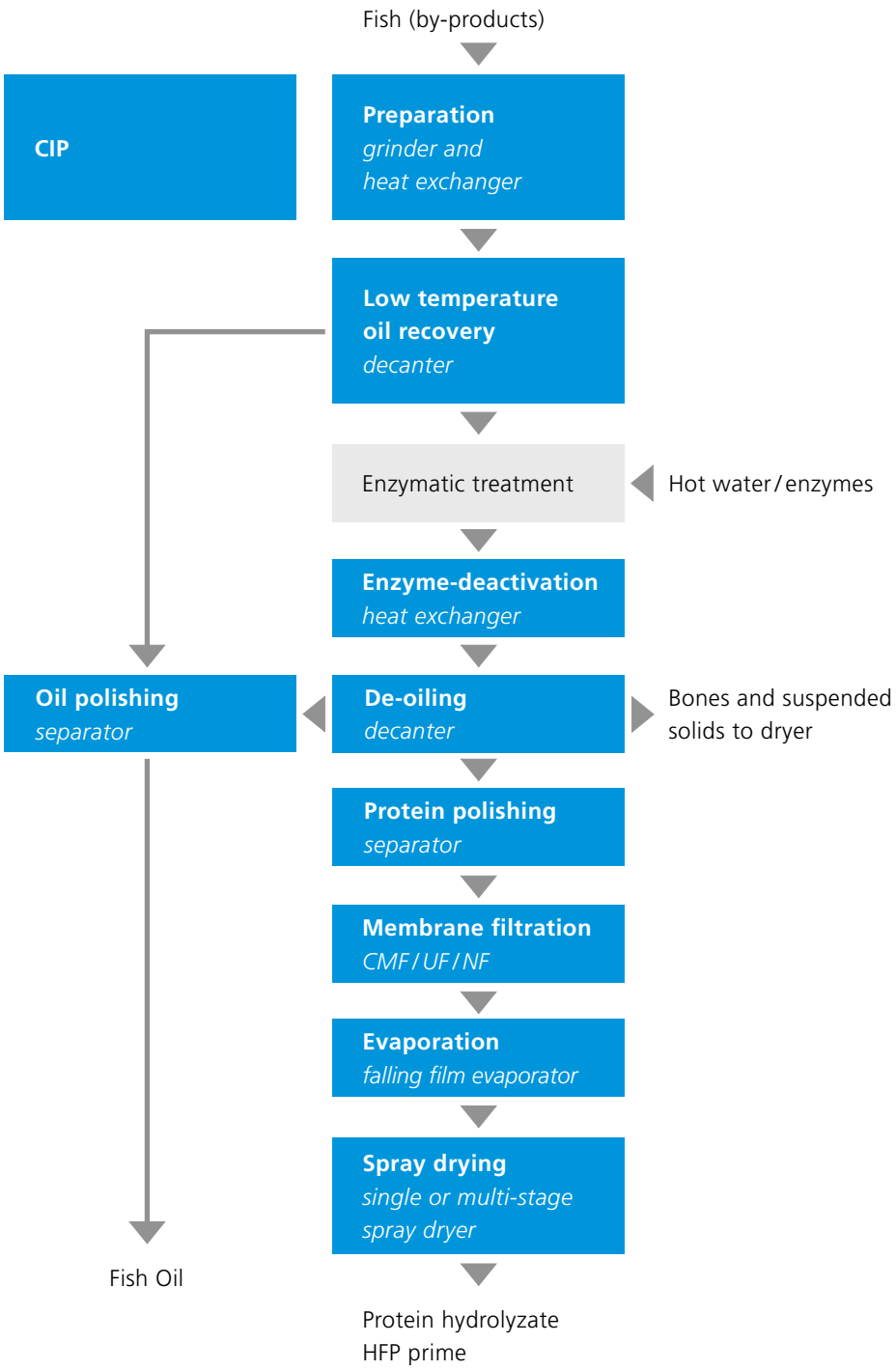
# For top protein quality – HFP prime

## Minimum fat content of less than 1 percent and protein content exceeding 90 percent

The protein rich water phase from the decanter is first polished with a centrifugal separator. Subsequently, a ceramic microfiltration plant removes the very small fat and suspended solid particles from the water. Membrane filtration reduces impurities and ash content and improves clarity and taste of your proteins. It is essential if you aim for maximum protein quality. GEA offers several filtration solutions depending on the desired functional properties and process setups: from micro to ultra and nano filtration, up to reverse osmosis.

Our HFP prime process setup offers you maximum protein value due to top functionalities. Fat content of your end product is < 1 percent with protein content of > 90 percent.

## Low fat hydrolyzate (high protein quality)



# Keep it clean – hygienic processing

To process the obtained proteins in the food industry – e.g. as food ingredients – hygienic processing is required. Our expertise in safe and smart CIP solutions has grown out of our extensive partnerships with the dairy processing industry.

### Usual requirements for hydrolyzate plants are

- Daily cleaning
- 20 hours production / 4 hours for CIP
- Fully automated CIP process
- Legal and safety regulations of the country
- Compliance with internal standards (e.g. HACCP)

## GEA OFFERS TWO OPTIONS FOR CIP PROCEDURES

### All or nothing: Cleaning of the complete process line

The advantages are:

- Lower investment
- Less piping demand
- Every product line is cleaned

But this also means:

- Long cleaning time
- High product losses due to inefficient pre-rinsing
- High contamination of CIP liquid
- Low cleaning efficiency
- No intermediate cleaning of single sections possible

### Pick and CIP: Cleaning of separate sections of the process line

This procedure is much more efficient. You can CIP separate sections while the rest of the line is still producing. On top of that, you can precisely tailor the cleaning conditions, e.g. cleaning intensity, capacity, CIP liquids, etc. to the requirements of the section and equipment. Some sections or parts of the equipment can be more easily cleaned than others and require less cleaning time or CIP liquids. Thus, an individual adjustment of cleaning conditions saves running costs and time.

Other advantages are:

- Short cleaning time due to parallel cleaning of different sections at the same time, also during emptying other parts of the process
- Low product losses
- Low contamination of CIP liquid
- Intermediate cleaning

Piping and installation requirements (valves, automation) for this procedure is higher though compared to the first option.

# Start to finish solutions for fish protein hydrolyzate production from GEA

Focusing on demanding and sophisticated production processes, GEA offers efficient and flexible solutions for customers in the fish processing sector – advancing both environmental sustainability and economic benefit.

## Grinding

- GEA PowerGrind – hole-plate grinders for efficient and gentle grinding

## Centrifugal Separation

- Disk separators
- Decanter centrifuges
- Customized centrifuge systems and package units

## Membrane Cross Flow Filtration

- Micro/ultra/nanofiltration & reverse osmosis
- Product-specific testing at own test lab and on site
- Skid-mounted

## Evaporation

- Falling film & forced circulation evaporation
- Vapor recompression heating concepts (MVR, TVR)
- Tubular or plate design, single- or multi-effect

## Drying

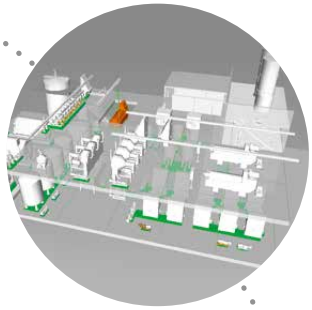
- Spray dryers
- Fluid bed dryers

## Service

- Installation, commissioning, training
- Spare parts, maintenance, optimization
- Performance contracts, on-site project support, service software products

## Test Facilities

- Cost assurance and process optimization
- Real-life simulations
- Test and loan equipment



## Process Engineering

Process design and engineering •
Project management •
Plant installation and commissioning •

## Automation & Control Systems

Process automation and MES solutions •
Integrated company-wide network systems with corresponding MES •
Data capture and evaluation •

## Refrigeration & Sustainable Energy Solutions

Holistic view on entire production process •
Multi-temperature cooling plants resulting in lower energy consumption •
Heat pump technology to minimize carbon footprint •

## Cleaning-in-place (CIP)

Fully automatic •
Complete lines or sections •
Equipment in hygienic design •

## Packaging

Modified atmosphere packing •
Bag filling •
Rigid container filling •

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a better world

## We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA is a global technology company with multi-billion euro sales operations in more than 50 countries. Founded in 1881 the company is one of the largest providers of innovative equipment and process technology. GEA is listed in the STOXX® Europe 600 Index. In addition, the company is included in selected MSCI Global Sustainability Indexes.

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