

# TWIN SCREW versus SINGLE SCREW IN FEED EXTRUSION PROCESSING

HD



**CLEXTRAL**

A DIVISION OF

**GROUPE LEGRIS INDUSTRIES**

BOOSTING INDUSTRIAL PERFORMANCE

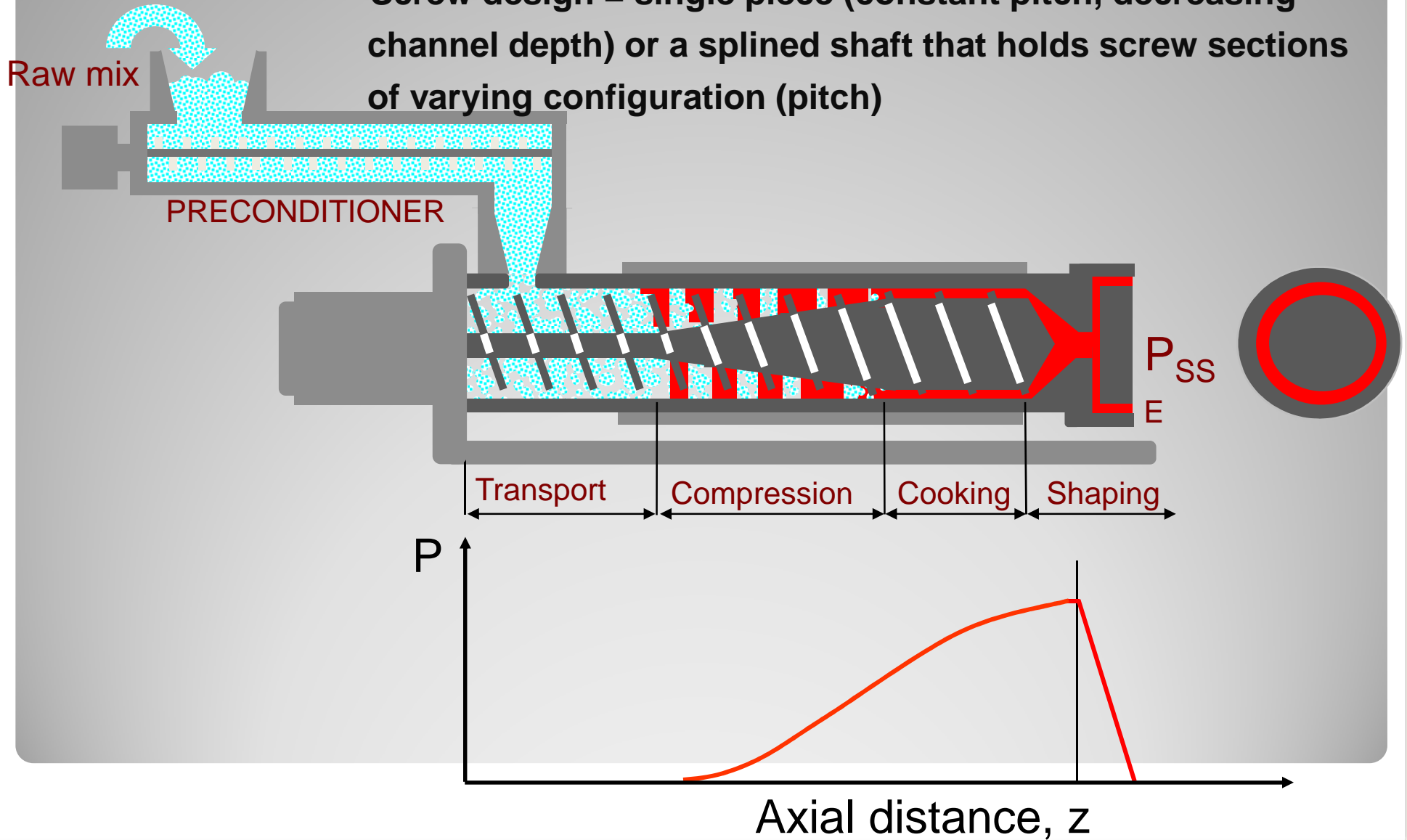
1. Technical basics
2. TSE improves your final product quality
3. TSE flexibility reduces raw material costs
4. TSE improves your throughput consistency



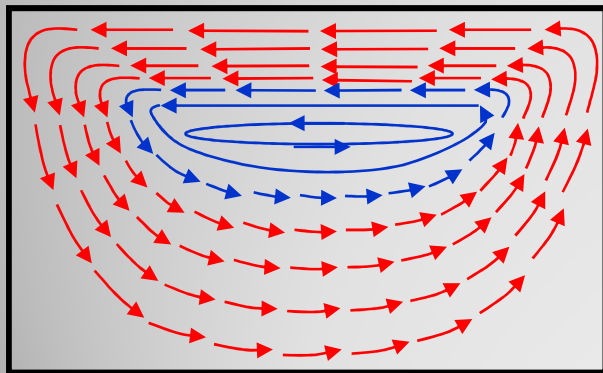
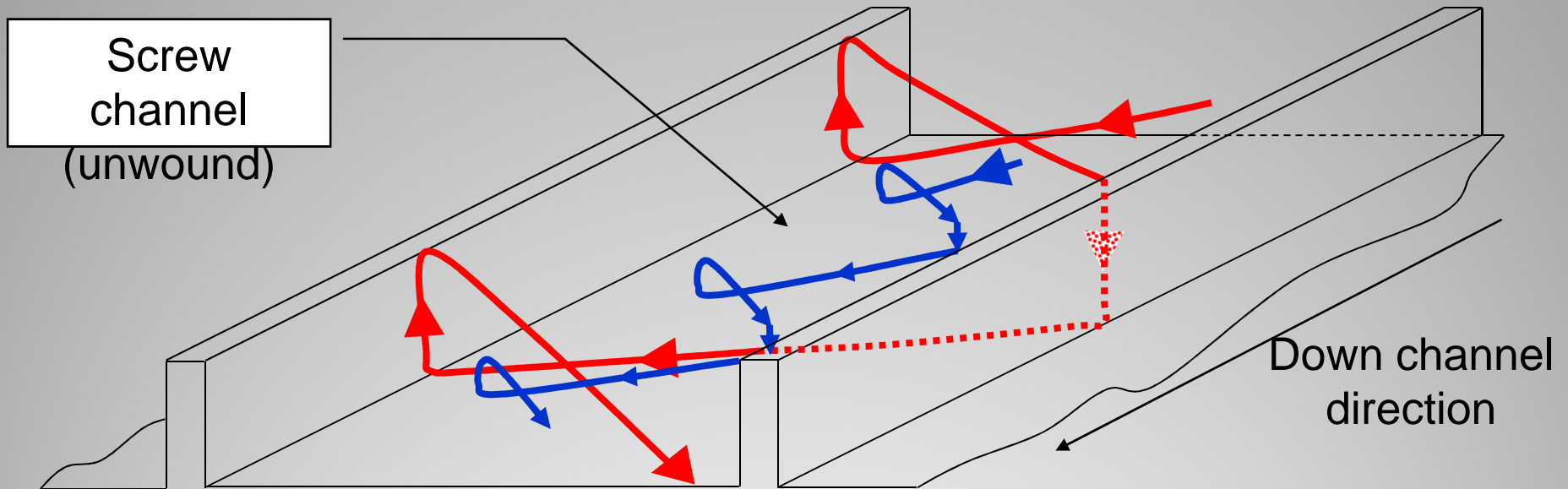
better ROI

# 1 : TECHNICAL BASICS

Screw design = single piece (constant pitch, decreasing channel depth) or a splined shaft that holds screw sections of varying configuration (pitch)



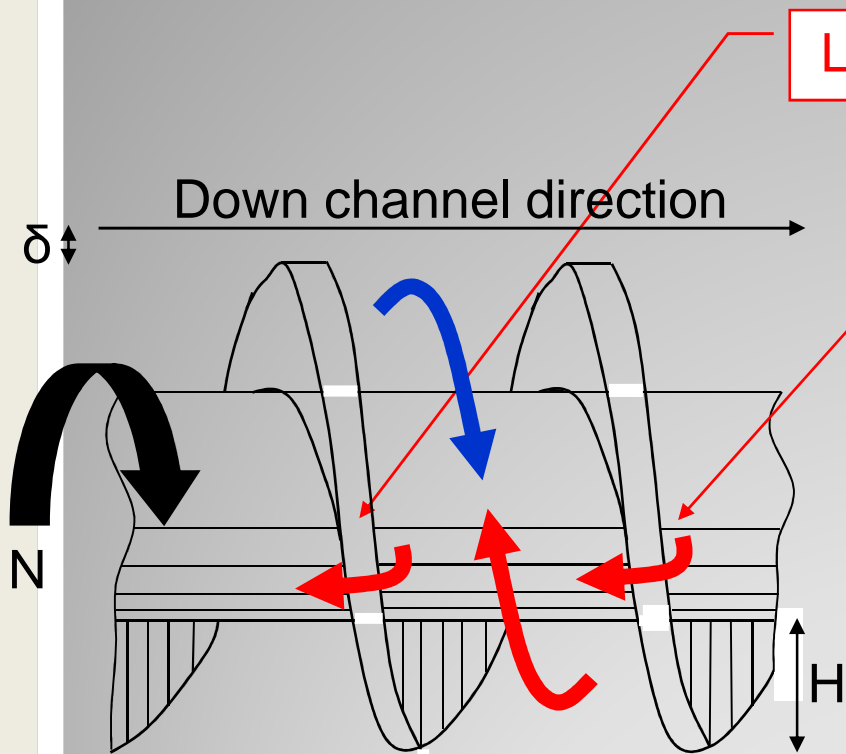
# 1 : TECHNICAL BASICS



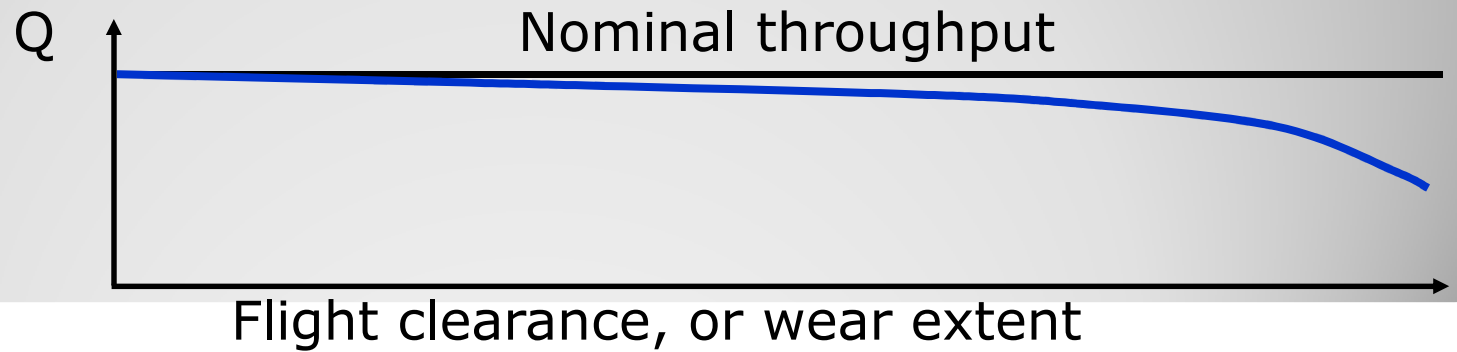
Flow pattern in the screw channel

- fluid particles have different velocities and do not interact, which leads to a dispersion of residence times and poor mixing.
- heat transfer as well as mechanical energy input in the cooking section are very limited. Moreover, the shearing effect is space-dependent, which generates heterogeneities of melt properties (cooking, temperature, strain, in particular).

# 1 : TECHNICAL BASICS



When the flight clearance or the screw wear increases, **LEAKAGE FLOW** is generated which decreases the extruder throughput

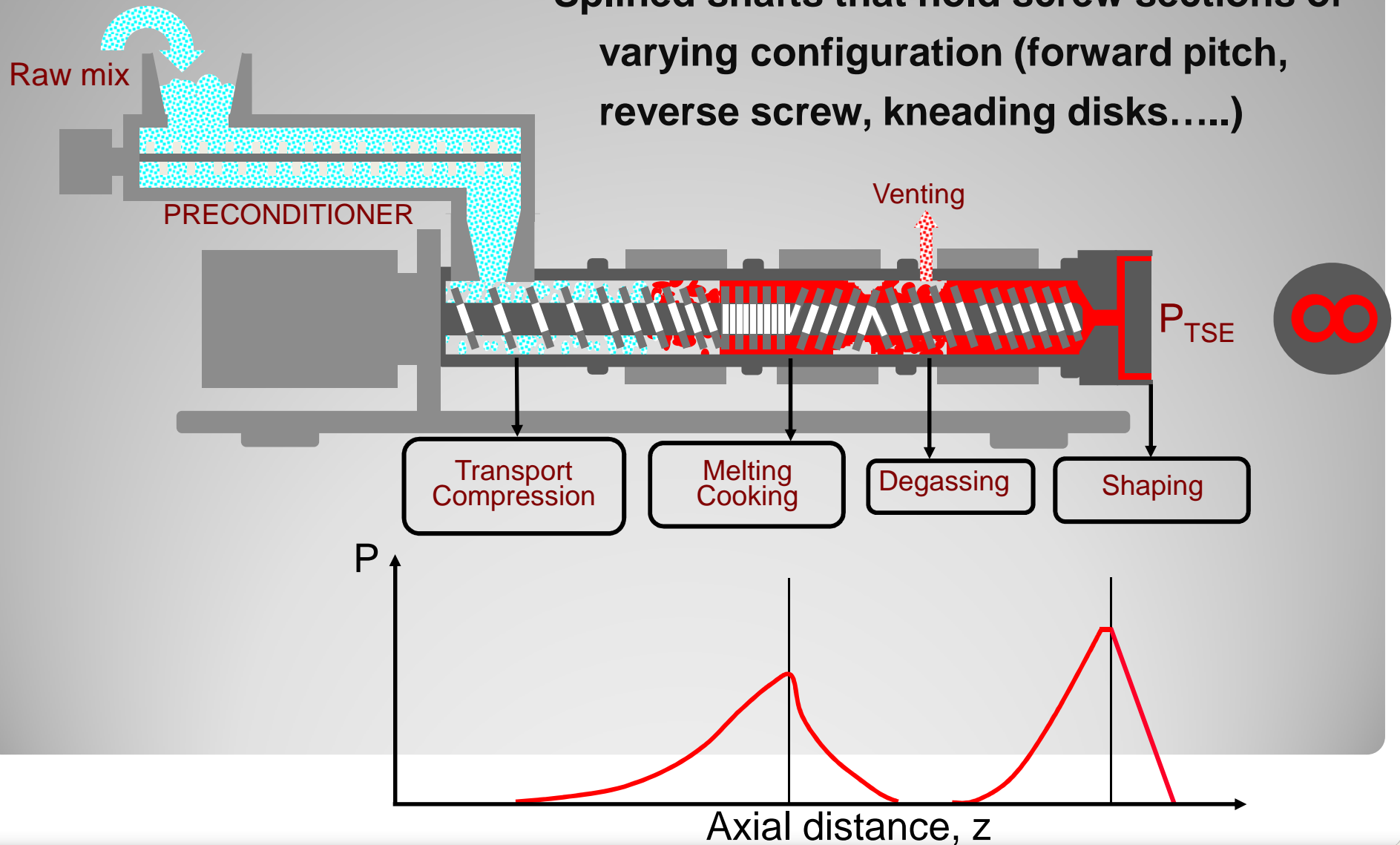


# 1 : TECHNICAL BASICS

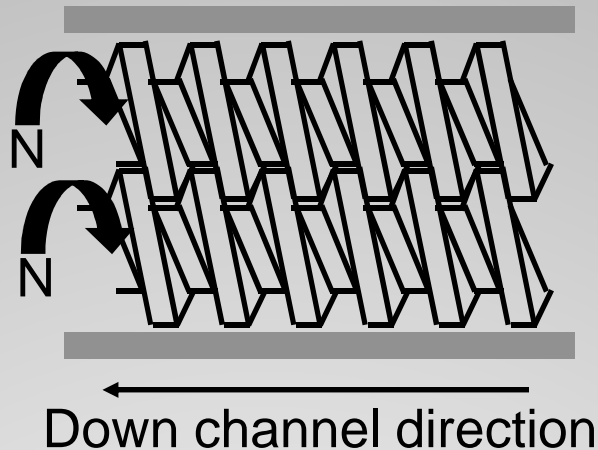
- ☑ **SSE Technology = ONE SINGLE PROCESSING SECTION.**
- ☑ **SSE Technology = dependence of THROUGHPUT and SCREW SPEED.**  
**SSE Technology = ONE SINGLE OPERATING POINT (throughput combined with max. screw speed and die opening area).**
- ☑ **SSE Technology = VERY POOR MIXING, which limits heat transfer, mechanical energy input, and generates heterogeneities of melt properties (cooking extent, composition, temperature, strain...).**
- ☑ **SSE Technology = as screw wear increases, EXTRUDER THROUGHPUT DECREASES. A decrease of 10-20% may be observed over the lifetime of the screw.**

# 1 : TECHNICAL BASICS

Splined shafts that hold screw sections of varying configuration (forward pitch, reverse screw, kneading disks.....)



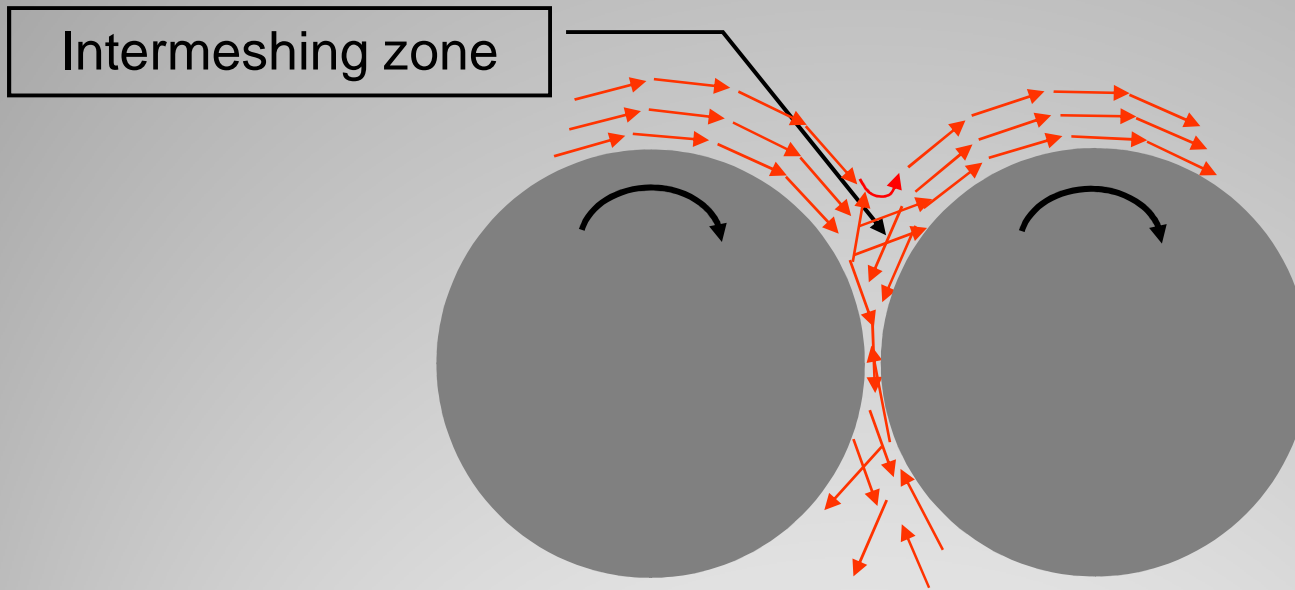
# 1 : TECHNICAL BASICS



**Corotating TSE is a POSITIVE DISPLACEMENT PUMP, thanks to the interpenetration of the screws. This allows to handle viscous, oily, sticky or very wet materials, with the same level of pumping efficiency.**



# 1 : TECHNICAL BASICS



**In corotating TSE, VERY INTENSE MIXING is observed in the intermeshing zone of the screws (macromixing, micromixing).**

**Consequently, heat transfer coefficient in the fully filled sections is high. Homogeneous melts can be obtained, with very good lipid binding. Die expansion develops consistently, which leads to give consistent product density, texture and shaping as well as uniform final product color.**

# 1 : TECHNICAL BASICS

- ☑ TSE = MULTIPLE FILLED PROCESSING SECTIONS IN SERIES.
- ☑ TSE = independency of THROUGHPUT AND SCREW SPEED.  
= MULTIPLE OPERATING POINTS, and SCREW PROFILES  
= modulation of mechanical energy input
- ☑ TSE = VERY INTENSE MIXING, which gives tremendous benefits in regards to product quality.
- ☑ TSE = WEAR compensated by SCREW SPEED increase.  
TSE = MELT SLIP compensated by POSITIVE PUMPING of the screws.

## **2 : TSE improves your final product quality**

- Uniform shape/size product**
- Regular structure/texture product**
- Uniform product colour**
- Smooth product surface aspect**
- Consistent product density**
- Better lipid binding**

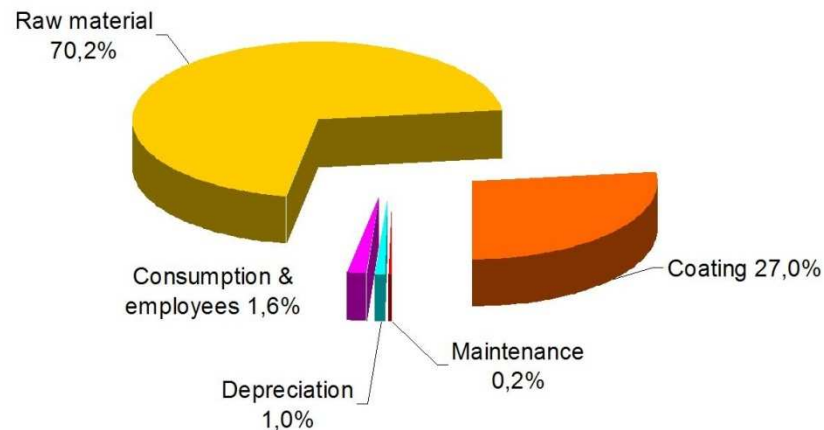
### **3 : TSE Production flexibility reduces feed mix costs**

- **Ability to vary extensively the ratio of Mechanical energy to Thermal energy, through screw speed and steam injection in particular, at constant throughput.**
- **Ability to handle variations of raw materials characteristics (moisture content, fat content, particle size, in particular), at constant throughput.**
- **Ability to handle process variables with the same level of process (throughput) and product performances, as well as the increasing use of vegetable proteins.**

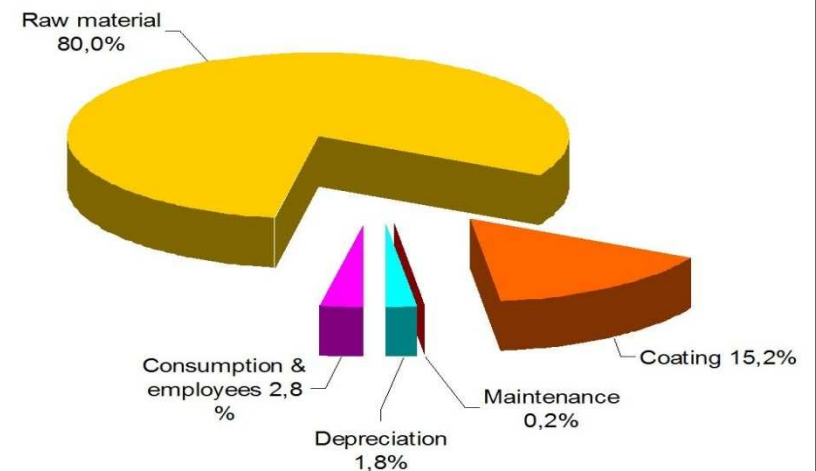
# 3 : TSE Production flexibility reduces feed mix costs

## PRODUCTION COSTS PER TON OF FINISHED PRODUCTS

### AQUAFEED PELLETS



### DRY PET FOOD



- Amortization and maintenance costs of a standard complete processing line do affect very slightly the production cost of finished products (approx. 2% impact).

### 3 : TSE Production flexibility reduces feed mix costs

Dogs/cats recipe Volume = 30.000t/y	SSE %	TSE %	Sav. %	\$/T	\$/T
Corn	30	25	5	135	8
Wheat	20	19	1	260	2,6
Meat meal	18	18			
Veg. proteins	8	8			
Wheat by-product	0	6	-6	100	-6
Others	24	24			
	100	100			<b>4,6\$/T</b>

**4,6 USD / ton x 30.000 ton / year = 138.000 USD / year**

## 4 : TSE improves your throughput efficiency

☑ As an illustration, a mid-size Pet food company in Europe, producing basic dry pet food (60%), a range of Premium (30%) and little Super premium (10%) products:

- Nominal capacity of TSE and SSE extruders: approx. 12 t/h , 240 t/day
- Average throughput consistency: TSE/SSE = 1/0.95  
=> Loss of SSE capacity/TSE:  $240 \times 24 \times 12 \times 0.05 = 3\,456$  ton/year
- Average selling price of products: 750 \$/ton (excluding cost of packing materials)
- Net profit of the plant: approx. 3%

Annual gain of TSE due to throughput consistency:  $3\,456 \times 750 \times 0.03$

**= 77 760 \$**

<b>Criteria</b>	<b>ROI impact</b>	<b>SSE</b>	<b>TSE</b>
Capital cost	Low	X X	X
Energy cost	Low	X	X
Maintenance cost	Very Low	XX	XX
Final product quality	High	XX	X X X
Flexibility	Very High	X	X X X
Output consistency	Very high	X X	X X X

**YOU GET WHAT YOU PAY FOR ...**



Our people make the difference



**CLEXTRAL**





ERROR: undefined  
OFFENDING COMMAND: Dr.is

STACK:

```
(7)  
/Title  
( )  
/Subject  
(D:20101203140521+01'00')  
/ModDate  
( )  
/Keywords  
(PDFCreator Version 0.9.5)  
/Creator  
(D:20101203140521+01'00')  
/CreationDate  
(dusica.ivanov)  
/Author  
-mark-
```