

# Flexible Impeller Pumps in the Food Industry

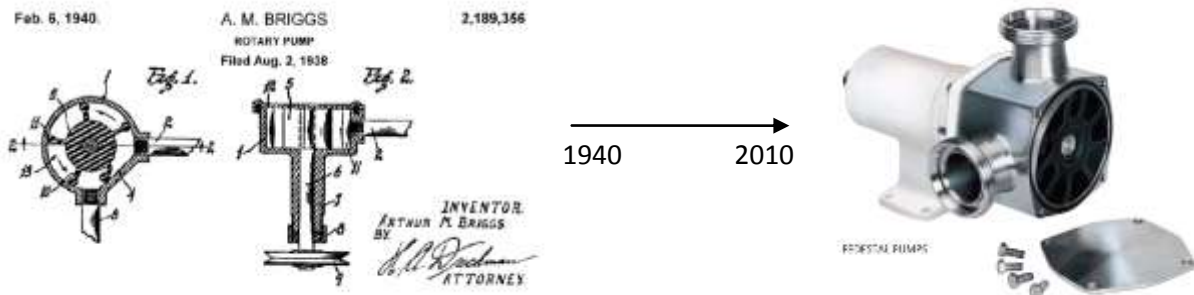
## One of the best kept secrets in pumping technology

The first question most people would ask is “what’s a flexible impeller pump?”

In the food industry the most common pump types would be centrifugal pumps, rotary lobe pumps, rotary piston pumps (often referred to as external circumferential piston or ECP), air-operated double diaphragm pumps (AODD), peristaltic or hose pumps and a plethora of other pump types. But flexible impeller pumps (hereafter referred to as FIP pumps) are a little known pump type. For those of you in the dairy industry you may already know the flexible impeller pump as the pump on the back of the milk collection truck.

### History of the Flexible Impeller Pump (FIP pump)

The pump was invented back in 1938 by Jack Streeter and Art Briggs in Burbank, CA as a condensate removal pump on a simple air conditioning system, and patented in 1940. They used their initials to create the name of the first company to produce this pump, **JABSCO** Pump Company. Since then the pump has been utilized in many applications including being a major player in marine engine cooling. Over the years Jabsco has developed the pump, utilizing different impeller and body materials, and finally in the early 60’s sanitary versions became available. Jabsco, now a part of ITT Flow Control, a Division within ITT Industries, is still the premier supplier of FIP pumps worldwide.



### How do FIP pumps work ?

The pump, as its name suggests, is a pump with a flexible impeller. To be more precise it is flexing vane pump. The impeller is made of rubber and is fitted into a concentric bore – See Figure 1. Inside the bore, between the suction and discharge ports, is a smaller diameter bore (cam). As the impeller rotates and the vane moves down a ramp from the small diameter bore to the larger diameter bore Fig 1, Pic 1, the cell formed between 2 vanes enlarges and consequently product is drawn into the pump thru the suction port. This ‘trapped’ product is carried around the body as the impeller continues to rotate Fig 1, Pic 2. As the vanes reach the discharge port area they start to move up a ramp from the large diameter to the small diameter Fig 1, Pic 3. The vanes are now being bent (flexed) and the cell between 2 vanes gets squeezed and the product is discharged. It’s that simple!

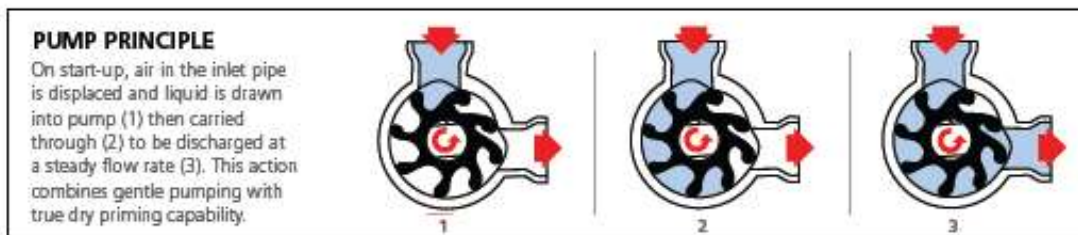


Figure 1

The performance characteristics of the FIP pump take advantage of both centrifugal pumps and positive displacement pumps. It has the head vs flow characteristic of a centrifugal coupled with the viscosity handling capability of a positive displacement pump. See figures 2 & 3 below.

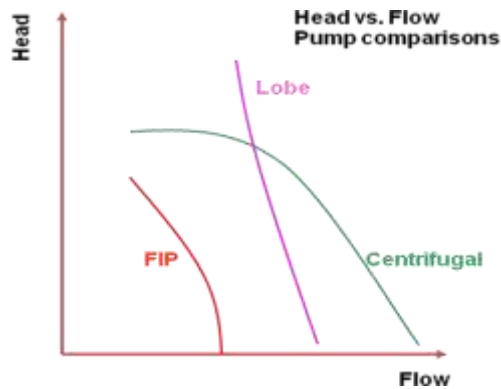


Figure 2

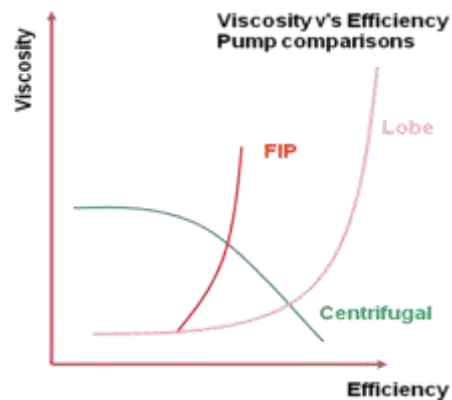


Figure 3

### FIP pumps offer food processors a unique combination of features

There is no other pump available on the market today that can offer the unique combination of features that the FIP pump offers. Table 1 below shows how the FIP stacks up against other pump types.

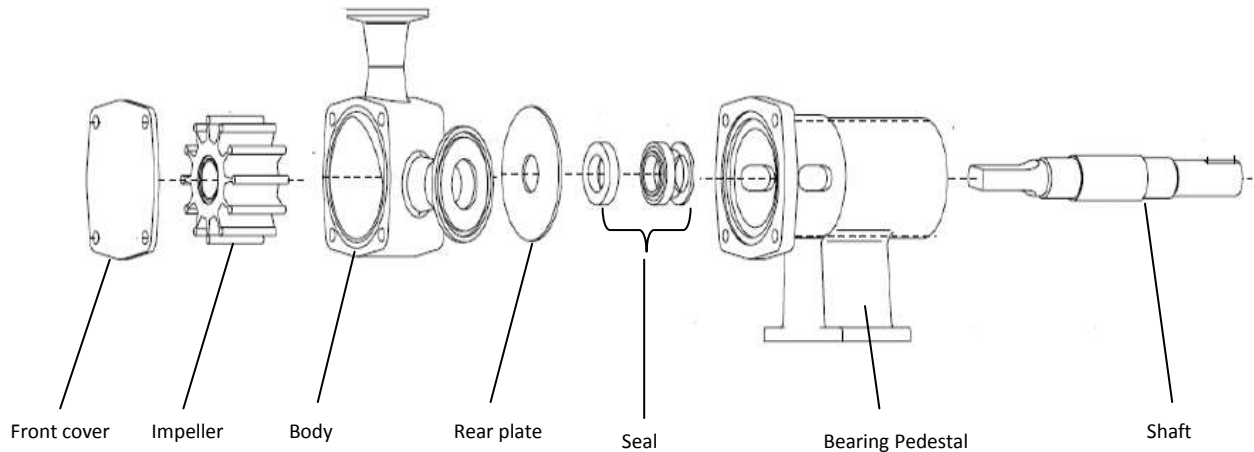
Pump Performance	Flexible Impeller	Rotary Lobe & ECP	Centrifugal	Air Operated Double Diaphragm
Pressure	Low	Low to High	Low to Moderate	Low
Temperature	Moderate	Low to High	Low to High	Moderate
Flow	Low to Moderate	Low to High	Low to Very High	Moderate
Viscosity	Low to High	Low to Very High	Low	Moderate
Speeds	Wide Range	Wide Range	Limited Range	N/A
Dry Self Priming	Excellent	No	No	Excellent
Air Entrained Liquids	Yes	Yes	No	Yes
Delicate Solids In Suspension	Yes	Yes	No	Yes
Hard Solids In Suspension	Yes	No	No	Yes
Abrasive Liquids	Moderate	Low	Limited	Yes
Corrosive Liquids	Moderate	Yes	Yes	Yes
Dry Run Capability	Up to 30 seconds	Yes	Yes	Yes
Smooth Flow	Yes	Yes	Yes	Pulsing Flow
Starting Torque / HP	Moderate	Low	Low	N/A
Power Consumption	Moderate	Low	Moderate	High
Relief Valve Required	Not normally	Yes	No	No
Continuous Duty	With Periodic Maintenance	Yes	Yes	With Periodic Maintenance
Ease of Cleaning	Yes	Yes	Yes	No
Ease of Maintenance	Simple	Complicated	Simple	Complicated

**Table 1** – How do flexible impeller pumps stack up against other common food process pumps?

With these features the FIP pump can perform many, but not all, of the duties of most other sanitary pump types, often at a fraction of the cost. In approximate terms FIP pumps cost around the same as a sanitary centrifugal pump, which size for size is around 1/3<sup>rd</sup> the cost of a rotary lobe pump.

## FIP Pumps follow the 'KISS' principle

We all know that one - Keep It Simple, Stupid. The FIP pump really only has one moving part, the impeller. There are no rotors to time, no shims, no gears. Below, Fig 4, is an example of a pedestal mounted pump.



**Figure 4** – Typical pedestal mount pump configuration

The **Jabsco** flexible impeller pump performance envelope is as follows -

- Flows from 1 to 185 gpm
- Viscosities from 1 – 50,000 cP
- Pressures up to 60 psi
- Dry-priming lift up to 20 ft
- Temperatures to 194°F
- Solids handling up to ½" soft or ¼" hard

...and their pump configurations include -

- Drive / Mounting configurations – pedestal, close coupled and bulkhead
- Impeller materials include – Neoprene, Buna (Nitrile) and EPDM - all food approved 3A and FDA
- Port sizes from 1" to 2 ½" – ACME (3A Bevel Seat) or Tri-Clamp
- Seals – include mechanical seals with carbon, ceramic or tungsten carbide faces with flush (quench) option

## Applications in the Food Industry

Applications for flexible impeller pumps in the food industry are many and varied and would be too many to list. They range from simple transfer to batching, metering, filling & dosing right through to complex process applications with flows directly linked to process streams.

Flexible impeller pumps truly are ***"The Flexible Alternative"*** to other pump types.

Here are a few examples –

**Dairy** – milk, yogurt, cheese curd, cottage cheese, cream .....

**Example 1 – Milk collection truck**

Product - 2" sanitary FIP pump, bulkhead mounted in the cabinet on the back of the truck

Duty - Pump is used to pump from the farm tank to the truck

Flows up to 165 gpm

Features utilized -



- Dry self priming to 20 ft – primes almost instantly through 15-20 feet of suction hose
- Low shear – does not damage milk globules or release free fatty acids
- Easy to clean – can be CIP'd or easily stripped for manual cleaning

**Example 2 – Cottage cheese transfer**

Product - 1 ½" sanitary FIP pump, foot mounted and coupled to a gear motor

Duty - Pump used to transfer cottage cheese to the header tank on a piston filler

Flows up to 20 gpm

Features utilized -



- Handles soft solids – does not break down the cheese solids
- Handles viscosities up to 50,000 cP
- Low cost when compared to other PD pumps
- Easy to clean – can be CIP'd or easily stripped for manual cleaning

**Beverage** – Water, wine, juice, concentrate, pulp.....

**Example 1 – Wine transfer**

Product - 1" thru 2½" sanitary FIP pump mounted on cart with VFD

Duties – Various - used to transfer from the fermentor to the press, press sump to de-stemmer, for must, for pump-over and for the wine itself

Flows up to 100 gpm

Features utilized -



- Handles soft solids – handles skins and does not clog
- Handles hard solids – is not damaged by seeds and stalks and does not get jammed
- Low cost when compared to other PD pumps
- Simple design – easy to maintain
- Easy to clean – can be CIP'd or easily stripped for manual cleaning
- Lightweight and portable

### Example 2 –Fruit juice concentrate

Product - 1"-2" sanitary pump mounted on a cart, close coupled to motor and utilizing VFD speed control

Duty - Pumping out of 55 gallon drums taken from storage freezer and transferring product to blending tank

Features utilized -



- Handles soft solids – does not break down the pulp sacs
- Handles hard solids – is not damaged by ice crystals and does not get jammed
- Dry self priming – pulls from drum with ease
- Low cost when compared to other PD pumps
- Easy to clean – can be CIP'd or easily stripped for manual cleaning
- Lightweight and portable

**Meat, Fish, Poultry** – Brine, rendering, gravy, pet food, meat sauce, meat slurry.....

### Example 1 – Brine injection

Product – 1" sanitary pump mounted in OEM equipment

Duty - Injecting brine into meat and poultry products

Features utilized -



- Simple design – easy to maintain
- Pump has 'self relieving' characteristics so no separate relief valve is required
- Easy to clean – can be CIP'd or easily stripped for manual cleaning
- Small footprint

### Example 2 – Batter coating

Product – 1½" sanitary pump mounted in OEM equipment

Duty – Supplying batter from the holding tank to the enrobing 'curtain'

Features utilized -



- Handles soft solids – handles small pieces of fish that fall through the conveyor belt and get recirculated into the batter mix
- Handles aerated product without air-locking
- Smooth flow – results in even 'curtain'
- Low cost when compared to other PD pumps
- Easy to clean – can be CIP'd or easily stripped for manual cleaning

**Bakery** – Cake mix, muffin batter with fruit, coatings, icing, fruit fillings.....

**Example – Donut glaze**

Product – 1½” sanitary pump

Duty – Recirculating donut glaze to the header tank on the enrober

Features utilized –



- Handles hard solids – small clumps of un-dissolved sugar and pieces of donut that fall through
- Abrasive wear can be compensated for with a new, low cost replacement impeller
- Low cost when compared to other PD pumps
- Easy to clean – can be CIP'd or easily stripped for manual cleaning

**General Food** – Batter, mayonnaise, sauces, dressings, pickles, relishes, salsa, honey, jams.....

**Example – Corn Chip batter**

Product – 2” sanitary pump mounted on a cart in-line coupled to motor and utilizing VFD speed control

Duty - transfer corn batter into chip forming machines

Features utilized -



- Handles hard solids – small clumps of un-dissolved batter
- Abrasive wear can be compensated for with a new, low cost replacement impeller
- Low cost when compared to other PD pumps
- Easy to clean – can be CIP'd or easily stripped for manual cleaning

**As you can see, it is clear that the Flexible Impeller Pump is a unique pump and capable of some pretty amazing feats. There truly is no other pump like it. It is definitely worth a second look.**