“Non Clog” Sewage Hydraulics

&

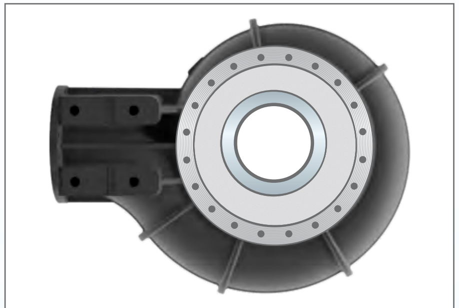
Optimization of

Energy v/s Non Clog Reliability

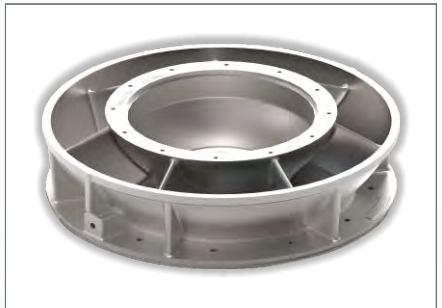
Hydraulics

1 **Hydraulics are generally broken down into Main Components :**

- **1.1** Inlet / Bell Mouths at the Starting of Pump
- **1.2** **Impellers**
- **1.3** **Casing** *(Volute / Bowl)*
- **1.4** Delivery / Piping Adaptors at the End of Pump



Pump Casing : Volute



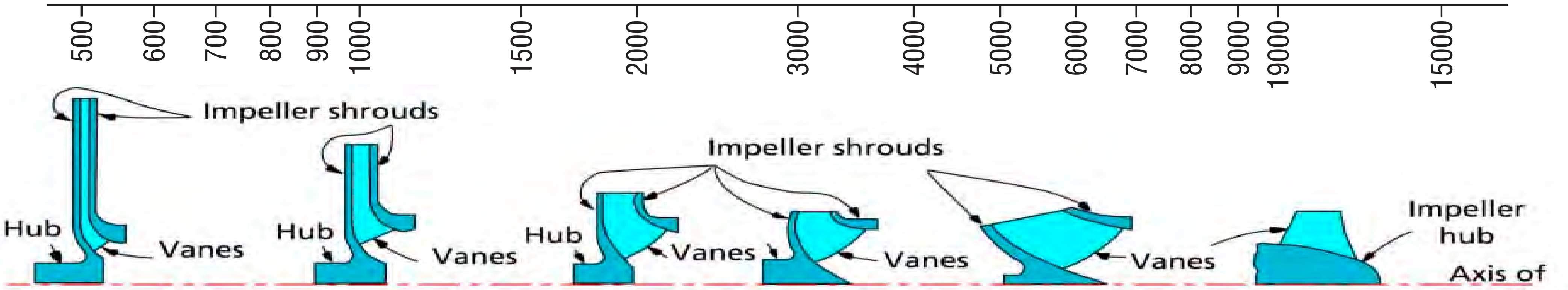
Pump Casing : Bowl

2. **Hydraulics are generally Classified by :**

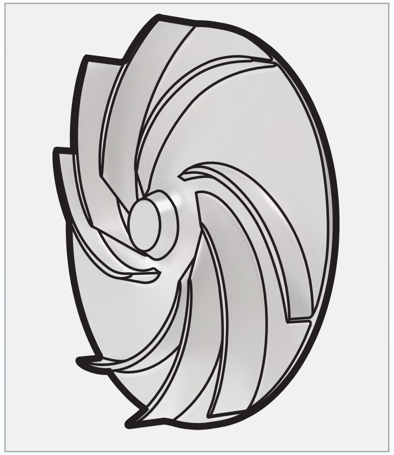
- **2.1** Specific Speed
- **2.2** Constructional Features

For the simplicity of this paper, which dwells on "Non Clog" Sewage pumps; we shall limit our focus on the **most Clog Prone componen**t & it's Constructional Features - i.e. the **Impeller.**

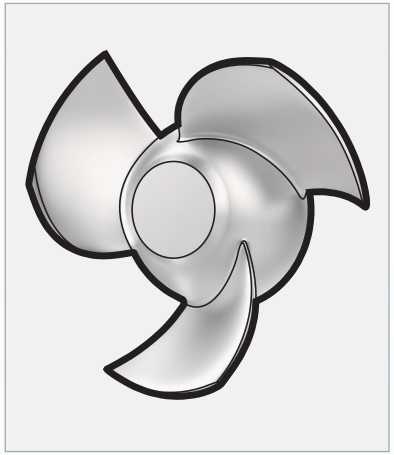
Values of **Specific Speed** (Single Suction)



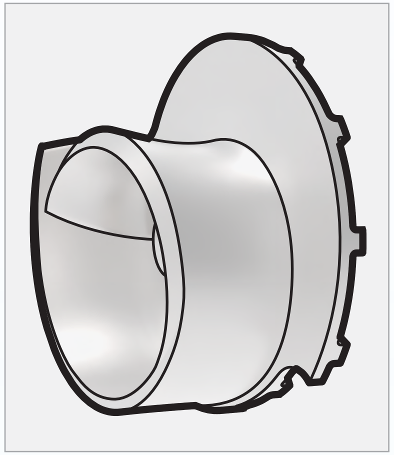
Radial - Vane Area **Francis - Vane Area** **Mixed - Flow Area** **Axial - Flow Area**



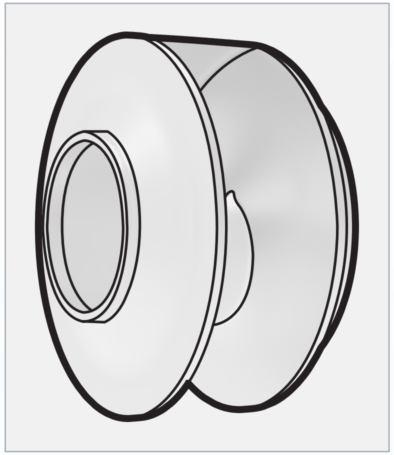
Vortex
VR



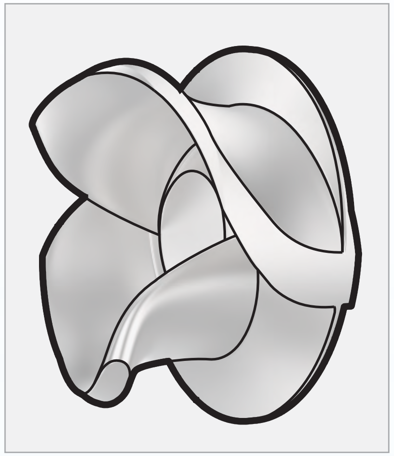
Propeller
AO



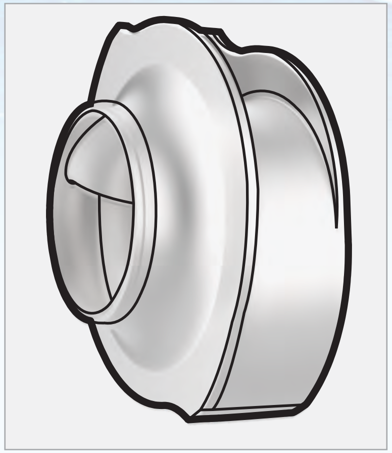
Single Vane **Semi Open**
SO



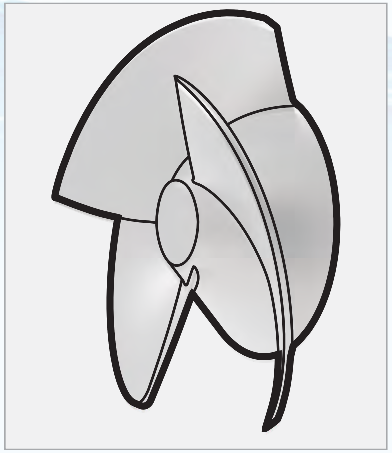
Single Vane **Enclosed**
SC



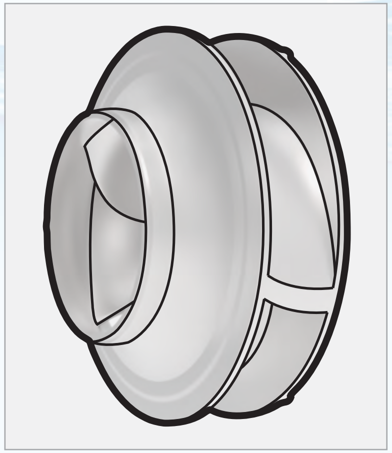
Two Vane **Semi Open**
DO



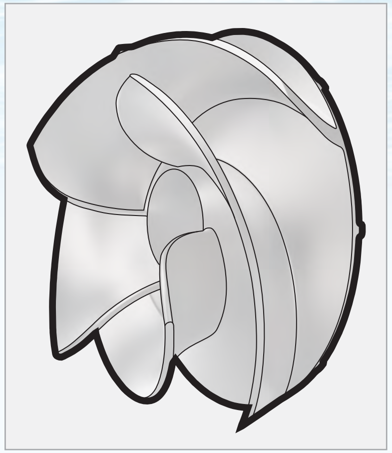
Two Vane **Enclosed**
DC



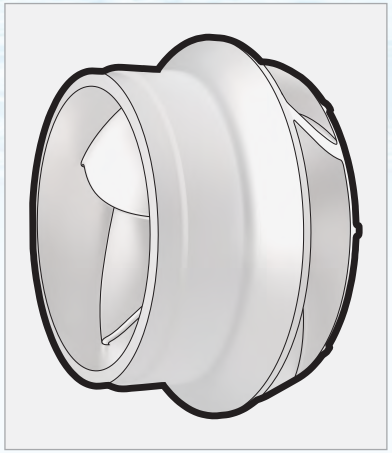
Three Vane **Semi Open**
TO



Three Vane **Enclosed**
TC



Four Vane **Semi Open**
MO_4V



Four Vane **Enclosed**
MC_4V

"Non Clog" Sewage Hydraulics : **Principle & Constructional Features**

Principle	Flow Direction *(Radial / Mix Flow/Axial)* w.r.t. Axis	Radial Vortex	Axial	Radial		Radial		Radial/Mix Flow		Radial/ Mix Flow	
	Flow Passage	Flow passes BELOW the Impeller Vanes	Channel *(flow Passes From WITHIN The Impeller Vanes)*								
Name	Typical	Vortex, Torque Flow, Free Flow	Propeller	Semi Open	Enclosed	Semi Open	Enclosed	Semi Open	Enclosed	Semi Open	Enclosed
	Aspect	**Vortex** *(VR)*	**Propeller** *(AO)*	**Single Vane, Semi Open** *(SO)*	**Single Vane, Enclosed** *(SC)*	**Double Vane, Semi Open** *(DO)*	**Double Vane, Enclosed** *(DC)*	**Three Vane, Semi Open** *(TO)*	**Three Vane, Enclosed** *(TC)*	**Four Vane, Semi Open** *(4O)*	**Four Vane, Enclosed** *(4C)*
Constructional Aspect	Number of Vanes	4 or 6 or 8	3 or 4 or 5	1		2		3		4	
	Back Shroud/ Hub	✓	±	✓	✓	✓	✓	✓	✓	✓	✓
	Front Shroud	✗	✗	✗	✓	✗	✓	✗	✓	✗	✓
	Wearing Rings *(Applicable for Enclosed Impellers)*	✗	✗	✗	✓	✗	✓	✗	✓	✗	✓

"Non Clog" Sewage Hydraulics : **Performance & Suitability**

Name	Aspect	Vortex *(VR)*	Propeller *(AO)*	Single Vane, Semi Open *(SO)*	Single Vane, Enclosed *(SC)*	Double Vane, Semi Open *(DO)*	Double Vane, Enclosed *(DC)*	Three Vane, Semi Open *(TO)*	Three Vane, Enclosed *(TC)*	Four Vane, Semi Open *(4O)*	Four Vane, Enclosed *(4C)*
Typical Performance	Non Clog Reliability	★★★★★	★★★★★	★★★★	★★★	★★★	★★	★★	★	★★	★
	Efficiency	★	★★★★★	★★	★★★	★★★	★★★★	★★★★	★★★★★	★★★★	★★★★★
	Typical Head	Low Med.	Very Low	Low Med.	Low Med.	Medium	Medium	Medium	Medium	Med. High	Med. High
	Typical Flow	Low Med.	Very High	Low Med.	Low Med.	Medium	Medium	Med. High	Med. High	High	High
General Suitability for Handling *(does not account for Pump Size)*	Maximum Gas content	8%	2%	4%	2%	4%	2%	2%	1%	1%	-
	Fibrous Solids content	Very High	High	High	Medium	High	Medium	Medium	Low	Low	Very Low
	Size of Solid	Large	Large	Large	Large	Medium	Medium	Low Med.	Low Med.	Low	Low
	Max Total Solids content	8%	6%	6%	6%	5%	5%	4%	4%	2%	2%
	Max Sand/ Ash/ Grit content	6% to 10%	6%	6%	4%	6%	4%	6%	4%	6%	4%
Generally Recommended / Suitable for	UnScreened Raw Sewage	★★★★★	★★★★★	★★★★★	★★★	★★★★	★★★	★★★	★★	★★	★
	Screened Raw Sewage	★★★	★★★★★	★★★	★★★★	★★★	★★★★	★★★	★★★★	★★★★	★★★★★
	Waste Water with Stringy Materials	★★★★★	★★★★★	★★★★★	★★★	★★★★	★★★	★★★	★★	★★	★
	Storm Water	★★★	★★★★★	★★★★★	★★★	★★★★★	★★★★★	★★★★★	★★★★	★★★	★★
	Gritty Waste Water	★★★★★	★★★	★	★★★	★★	★★★	★★	★★★★	★★	★★★★
	Sewage Sludge *(RAS, SAS, Digested)*	★★★★★	★★★★	★★★★	★★★	★★★★	★★★	★★★	★★	★★	★
	Industrial Waste Water	★★★★★	★★★	★	★★★	★★	★★★	★★	★★★	★★★	★★★★
	Mixed Liquor - MLSS	★★★★★	★★★★★	★★	★	★★★	★★	★★★★	★★★	★★★★★	★★★★
	Supernatant / Centrate / Filtrate	★	★★★★★	★★	★	★★	★	★★	★	★★★★★	★★★★
	Treated WW	✘	★★★★★	★	★★	★★	★★★	★★	★★★	★★★	★★★★★
	Service / Wash Water	✘	★★★★★	★	★★	★★	★★★	★★	★★★	★★★	★★★★★

Materials of Construction *(MoC)* of Hydraulics

Raw Sewage in **Developing Countries** often :

1. has Poorer Screening & often mixed with Residual Construction Waste *(of UGD)*; allowing Large *(often Hard)* Sized Solids *(like Coconuts, Bricks, Stones, Pebbles, etc)* into Pumps.
   - 1.1 This requires **Tough Crack Resistant** MoC for Impeller - surely Brittle MoC like **Cast Iron** for Impeller is **not recommended**.
2. Is Mixed with Storm Water; leading to **Higher Content of Sand & Grit** into Pumps
   - 2.1 This requires **Abrasion Resistant** MoC for **Wearing Rings** *(of Enclosed (if) Impeller)* - surely MoC like **Bronze** or **Cast Iron** is **not recommended**.

In most cases, for Low to Medium Head, **Storm Water / Raw Sewage / IPS / TSPS** Pumps :

1. used for **Storm Water** :
   - 1.1 Impellers of Spheroidal Grey / Ductile Iron ***(SG/ DI)*** are the Minimum MoC Grade &
   - 1.2 maybe Upgraded to *(Austenitic)* Stainless Steel **CF8** *(loosely called SS304).*
   - 1.3 Use Costlier of Austenitic Stainless Steel **CF8M** *(loosely called SS316)* & more so that of Duplex Stainless Steel **CD4MCu may just be not only a Waste of Money - they may also be Counter Productive...!**
2 used for **Municipal Sewage** *(with or without Storm Water mixing)* **Not** Mixed with/ with **Traces** of **Industrial Effluents** :
   - 2.1 Impellers of *(Austenitic)* Stainless Steel **CF8** are Optimal.
   - 2.2 Optionally, Stainless Steel **CF8M** maybe used - but please note that CF8M is Softer than CF8 & hence it may Erode faster..!
   - 2.3 Use of Duplex Stainless Steel for Impeller may just be not only a **Waste of Money** - it may also be **Counter Productive** *(as they are not as easily Weldable like CF8 or CF8M)* unless the MoC of **All the Other Parts of Pump are Also Upgraded** to Stainless Steel - a very Costly affair indeed..!
3. used for **Municipal Sewage** *(with or without Storm Water mixing)* **Mixed with Industrial Effluents** :
   - 3.1 Impellers of *(Austenitic)* Stainless Steel **CF8M** are Optimal.
   - 3.2 However, **detailed Chemical Analysis** of Liquid is required & the Need to Upgrade the **Other Parts of Pump** *(like Bell Mouth, Volute/ Bowl Casing, Pump Casing Cover (if), Impeller Back Cover (if), etc)* to More Corrosion Resistant MoC *(than Cast Iron)* may arise.
     - 3.2.1 Generally **CF8M Impeller**, Balance **Pump Parts** in **CF8** with **Shafts** of **SS410** may be a starting point; in absence of detailed Chemical Analysis.

Optimization of Energy v/s Non Clogging

Preamble : Limitations of Existing Standards & Lack of Adequate Hydraulics

Within the Pump **Manufacturing Industry**, relatively **Little Attention** has been devoted to Non Clog Hydraulic Designs - & even Less So to Specialized **Sewage Pump Hydraulics**.

This is evident when we study the **Hydraulic Institute Standard**'s *(HIS)* **Publication "*Rotodynamic Pump Efficiency Prediction HI 20.3*"** widely regarded as the **Benchmark** for **Predicting** the **Efficiency** of Rotodynamic / Centrifugal pumps. While the Standard provides Efficiency for "***Submersible Sewage***" **pump Curve C**; it :

- Does Not further classify the Various **TYPEs** of **Impellers** - i.e. Vortex, Single Vane, Double Vanes, Triple Vanes, Four Vanes, Propeller, etc.
- Does Not discuss the *(generally Inverse)* Relationship of **Solid Handling Ability (Size) v/s Efficiency**.
- Does Not discuss the Relationship of Impeller **Enclosure v/s Efficiency** - i.e. Enclosed or Semi Open.

It Simply applies a Similar & Single Efficiency across All Types, Enclosures & Solid Sizes of Sewage pumps...!

Consider a hypothetical case of Low Flow (resulting into DN 50mm with typical velocities) x MED Head Sewage Pumps for :

1. IPS or LPS of UGD with Little or Poor Screening for **Raw Sewage Lifting** application - here despite DN50mm being the Hydraulically Best Choice, due to Large Sized Solids DN100 Pump is required & due to 100mm Solid Size & High Content of Fibrous Solids Semi Open Single Vane Impeller is required. Obviously, Pump Efficiency has to suffer for achieving Non Clog Reliability.

&

2. Dual Screened, DeGritted, **Mix Liquor Recirculation** application - here DN50mm with Enclosed Two or Three Vane Impeller would work fine & High Efficiency *(as indicated in HIS 20.3)* would not only be achievable **- it'll be sustainable as well.**

Preamble : Limitations of Existing Standards & Lack of Adequate Hydraulics

One possible reason for this **OverSimplified approach** by HIS 20.3 *(& most Pump Manufacturers)* may be, that; in many **Developed Countries; Sewage** is generally :

1. Well Screened,
2. More Diluted,
3. Free of Industrial Effluents,
4. Has better Segregation of Solid Waste & Storm Water,
5. Has Lower Ongoing works of Connections/ Corrections/ Enhancements to Sewer Network leading to less Bricks, Gravel, Cement/ Cement Bags, etc mixing - i.e. **is Much More Easier to handle** by Pumps *(compared to Developing Countries).*

As a result, Non Clog or even Sewage Hydraulic Designs of Developed Countries **may be Designed Primarily for High Peak Efficiencies Rather than for Handling Large Solids, High Content of Solids, Fibrous & Stringy Wastes, Construction Debris & Grit** commonly encountered in many developing regions.

Hence, sometimes; using these Benchmark Efficiencies of HI 20.3 or European Pump Manufacturer's Catalogues for Raw Sewage of IPS, LPS, TSPS, etc may Not only MisLead Energy Consumption estimates - their UnSustainable High Efficiency may **also Lead to a Smaller Motor kW Ratings** - indeed a Recipe for **Repeated Motor Failures** during the O&M phase.

Disclaimer : We do not challenge the Correctness of HIS & infact Endorse it's usage for Water Hydraulics for which we do consider it to be a Global Benchmark including Developing Countries *(as Water handling in Developed Countries isn't dramatically different {as Sewage} than Developing Countries).*

Preamble : Limitations of Standards & Lack of Adequate Hydraulics

In this era of Aggressive Bidding *(wherein Overall Energy Consumption is becoming the "differentiating factor" between Bidders)*, often the Sewage Process Designer falls prey to Un-Scrupulous/ In-Experienced Pump manufacturers & chooses Very High Efficiency Pumps *(often with Smaller than Ideal Motor Ratings (which accentuate Field Failures))* even for Applications Prone to High Risk of Clogging *(say IPS of UGD)* – hence, he suffers the most during the O&M stages.

- Calculated **Energy Costs** are a Prime concern for **Administrators/ Management** – while Actual **Non Stop, Non Clogging Pump Performance** is a **Prime** concern for **Engineers/ Operators.**
- **Even the most ultra-efficient pump is useless, if it Clogs & Stops** – while on the other hand, even the most Non Clog Resistant pump i**s useless**, if it consumes *(or rather wastes)* Energy.
- To quote **Fraser – Sabini** from **Proceedings of Turbo Machinery, Texas A&M University** *(1981)*:

  "It is important therefore, to consider not only the efficiency of any pump selection, but also the effect of component life and mechanical reliability on efficiency. In general an increase in component life and mechanical reliability means a reduction in the maximum efficiency attainable. For most applications, an economic evolution should be made of the power costs and maintenance costs over the life of the pump to arrive at an optimum selection."

- Consider this hypothetical case of Replacing Material of a Passenger Car's Body from Heavy Weight Steel to Ultralight Plastic; surely it's Mileage will Increase – but with Reduced Safety.
- Hence this Paper is published with an aim of Optimizing Pump Energy Consumption v/s Non Clogging Performance.

Before reading further, it is recommended to study our other Publications :

- **Tech Talk : Know Your Municipal WW & it's Cycle**
- **Tech Talk : Calculating Motor kW Rating**

General Principles

1. The ability of a pump to handle Solids effectively depends on several factors, like :

1.1. The **Size of Largest Solids** frequently expected – Generally the Solid Passage Size of Pumps should be equal to or larger than the expected solid sizes. Typical examples are Coca-Cola Tin Cans, Frooti Cans, Milk Pouches, Hand Towels, etc.

1.1.1 For a Non Clog Impeller to Pass Large Solids reliably, it's Internal Passages must be large enough.

1.1.2 As the required Passage Size Increases, unless the Flow Also Increases; generally Lower Number of Vanes or Vortex impellers are required.

1.2. The **Form & Nature of Solids** – generally **Stringy, Fibrous** waste; even if small in size in one dimension but long rope like in the other; have a Tendency to "Bunch", "Plait" around the Vanes of Channel Impellers & over a period of time they can "Lock" the impeller. Typical examples are Tyres, Tubes, Cement Raffia Bags, Jute Strings, Textile waste, Contraceptives, Hyacinth & Water Grown Vegetation, etc.

1.2.1 This calls for Self-Cleaning Impeller + Casing designs – either Semi Open Impellers in Small to Medium pumps or Vortex Impellers for Small pumps.

1.2.2 Aqua's **"ContraBlock Plus"** are an excellent option of Self Cleaning hydraulics.

1.3. The **Hardness of Solids** – generally Fine Hard solids like Sand, Ash, Grit & Gravel are Not Clogging in nature; but they can cause Severe Erosion on pump's Close Clearance Joints leading to Accelerated Drop of Pressure & Efficiency.

1.3.1 This effect is especially Harsh on Enclosed Impeller's Wearing Rings - this calls for Special Materials of Construction of pump internals & designs which do not require close running gaps.

1.3.2 Aqua's **"Smart Set" Hydraulics** are an excellent option to Mitigate Drop of Efficiency & Avoid Excessive Spare Parts Costs.

General Principles

2. **Increasing Head**, generally requires - Increased Impeller **Diameter** &/or Increased **Speed** &/or Increased **Number of Vanes**

3. For the Same Number of Vanes, **Enclosed** Impellers will generally have Slightly **Higher Head & Efficiency** *(as compared to Semi Open Impellers)*

4. For **Raw Unscreened** Sewage &/or Storm Water - especially with **Low to Medium Flow** Rates, **Semi Open** or **Vortex** Impellers maybe Better with respect to Non Clog Reliability

5. For Raw Activated Sludge *(RAS)* / Secondary Activated Sludge *(SAS)*; **Low Speeds** *(say 960rpm)* are Recommended by some Process Engineers to ensure survival of Biomass - sometimes, this Low Speed *(especially with Low Flow pumps)* may unfortunately Reduce Peak Attainable Pump Efficiency. However, **to Regain / Improve Efficiency**; these :

   5.1 Impellers maybe **Enclosed** - i.e. need Not be of Semi Open type *(as no Long Fibrous or Large Solids are expected, necessitating Semi Open Impellers)*

   5.2 Required **Solid Handling Size** maybe **Reduced**

6. Apart from just focusing on Maximum Solid Size;
   - Total Solids Content,
   - Content of Fibrous Solids,
   - Grit/ Sand Content,
   - pH,
   - Viscosity,
   - Maximum Gas Content,

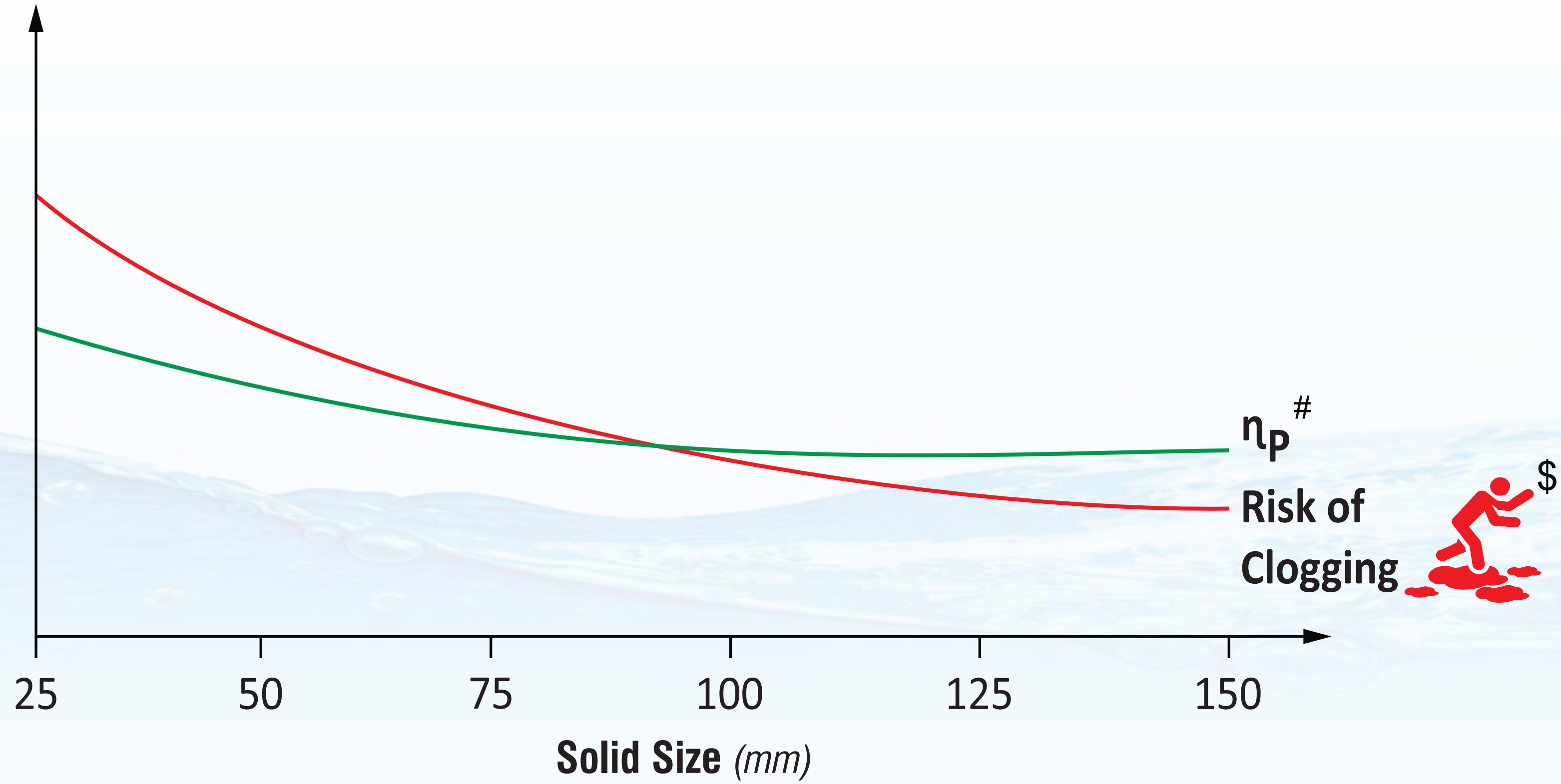
etc, may also be considered.

Larger than required Solid Handling Capacity & /or **Unnecessarily Low Speed** & /or **Very High Clear Water Efficiency in Purchase Specifications may lead to Poorer than Optimal Reliability, Clogging & Field Efficiency...!**

General Principles

Solid Handling Ability *(Size) (for Similar Flow)* **:**

- Generally Pumpsets with Lower Solid size will be more Efficient *(& hence have Lower Power Consumption)* BUT may be more prone to Clogging *(for UnScreened Liquids)*.



Risk of Clogging & η_p

Hence Selection of Larger than Required Solid Handling Size of pump may Reduce it's Efficiency & Reliability ...!

Symbol Legend *(Annotations)*:

*Some models have nearly same Efficiency in both Semi Open as well as Enclosed impellers.*

$ *For Medium & High Specific Speeds (i.e. Low to Medium Head & Medium to High Flows & Medium to High Speeds); the Risk of Clogging does NOT increase even with an Enclosed impeller...!*

- **Know the Entire Chain of Sewage Handling :**

Primary Nature / Concern of Liquid to be Pumped

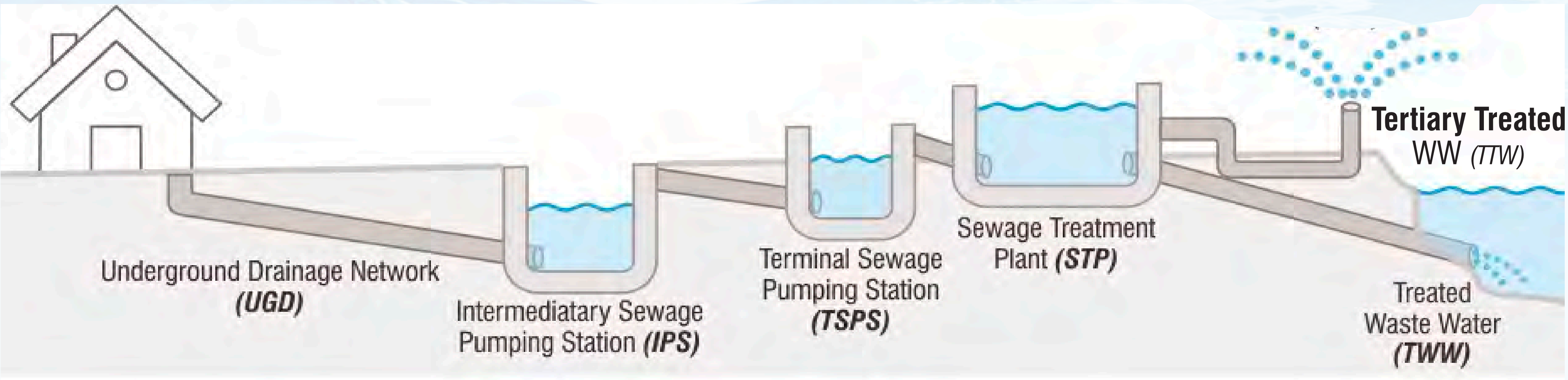
Solids	Sludge	Reasonably Clear Water

Unscreened Sewage

Screened Sewage

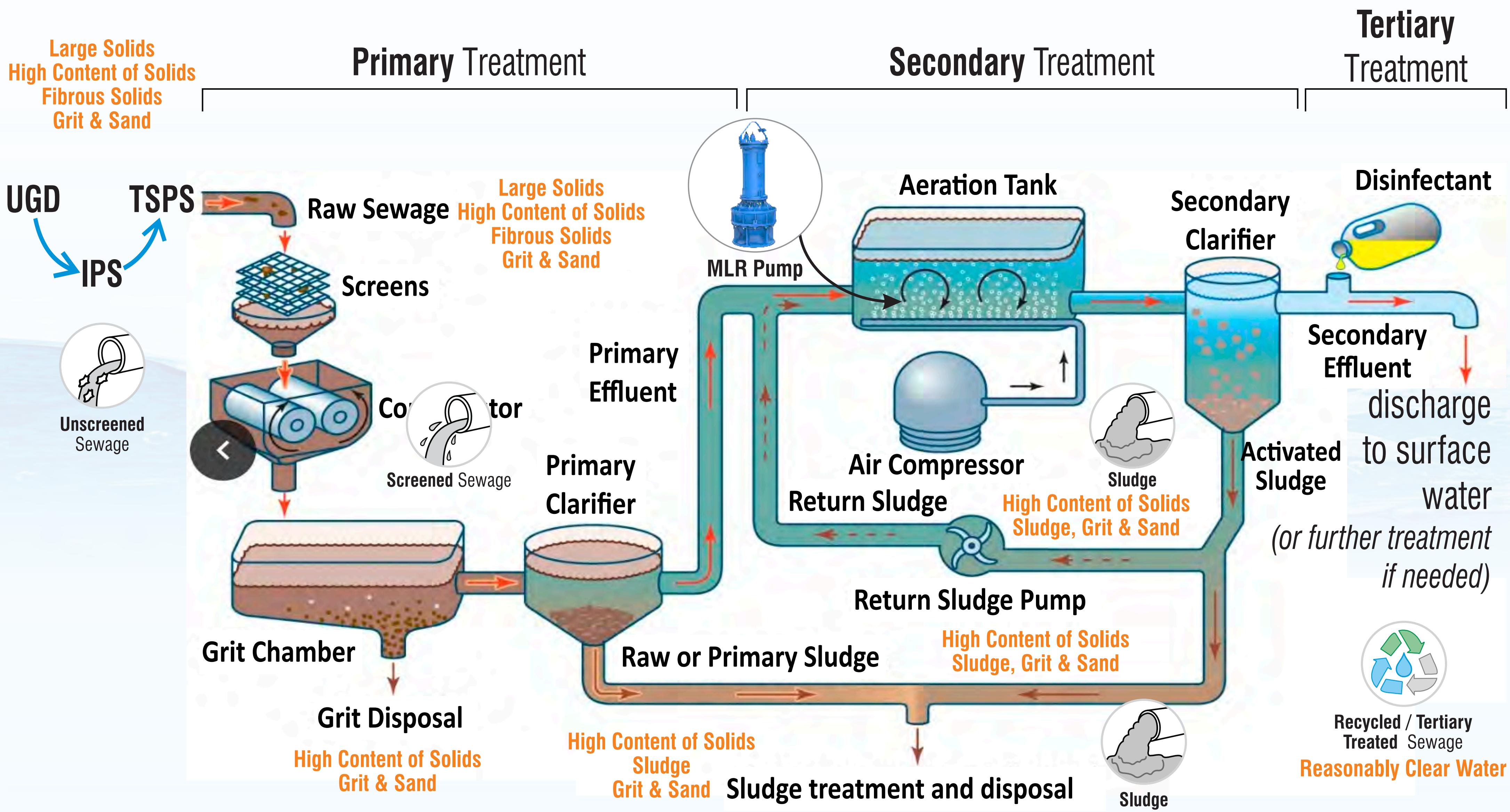
Sludge

Recycled / Tertiary Treated Sewage



- **Sewage Treatment Plants :**

Primary Nature / Concern of Liquid to be Pumped



Aqua's 2nd generation of Submersible Sewage Pumps

A concept for 20th century Europe - a pump for 21st century World !

The 1st generation Submersible Non Clog pumps used in India were either **designed for European conditions** or based on these European pumps *(either through inspirations or collaborations)*. However the Indian *(& most developing countries)* have Operating Conditions that are drastically different *(much harsher on pumps)* - for e.g. :

1. Due to Lack of Dedicated Storm Water Drainage &/or due to Lack Screening, **Large Sized Solids** are often encountered by pumps.
2. Due to Poor Screening, **Lots of Fibrous Waste Solids** are almost always encountered by pumps.
3. Due to Lack of Dedicated Storm Water Drainage; **High Content of Ash, Grit, Sand** is encountered which can Accelerate the Erosive Wear of pump internals.
4. Due to Lower Per Capita Water Supply, **Higher Viscosity & Gas Content** can be encountered.

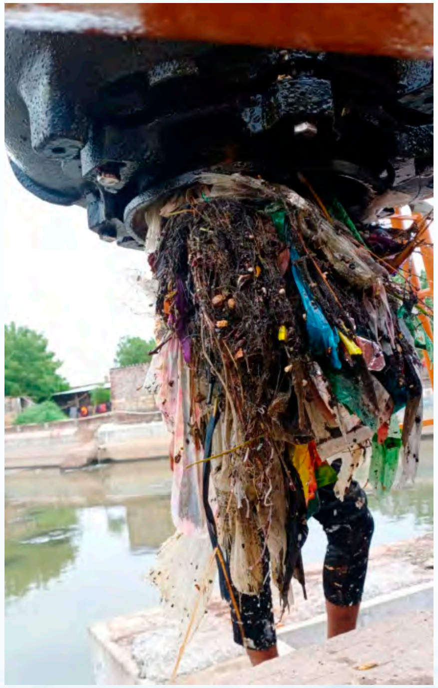
hence Non Clog Hydraulics developed for European conditions, while being Efficient - are Prone to Frequent Clogging..!

Aqua has arguably the Best Research & Development Department *(amongst the Dedicated Submersible Pump Manufacturers All Across the Globe)* & our Extensive Field Experience was the Key to Realizing this Mismatch *(between European Design & Indian Practical Operating Conditions)* - **Aqua's ANS is the First 2nd Generation of Submersible Sewage pump specifically designed for real life operating conditions of developing countries.**

Aqua's Extensive Range of Hydraulics, Reduces Energy Costs upto Practical Limits WITHOUT inviting the Risk of Clogging for Each & Every Possible Pumping Applications in Entire Waste Water Cycle.

Problem with Small & Medium sized Pumps

In Small & Medium sized Pumps, Enclosed Impellers *(despite having Large Solid Handling Abilities)* can Easily Clog due to High Content of Small Sized Fibrous Solids - this problem cannot be Averted by Simply selecting even "***Larger Allowable Solid Size***"...!

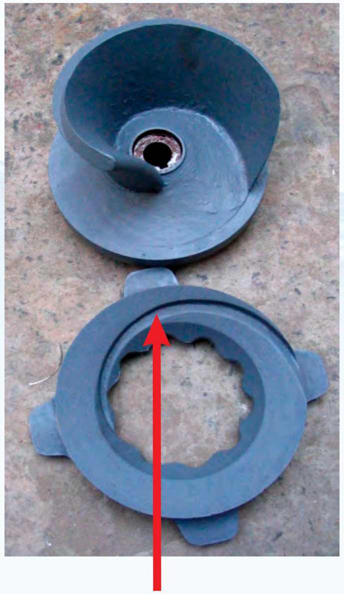


Solution : Aqua's "ContraBlock Plus " Hydraulics

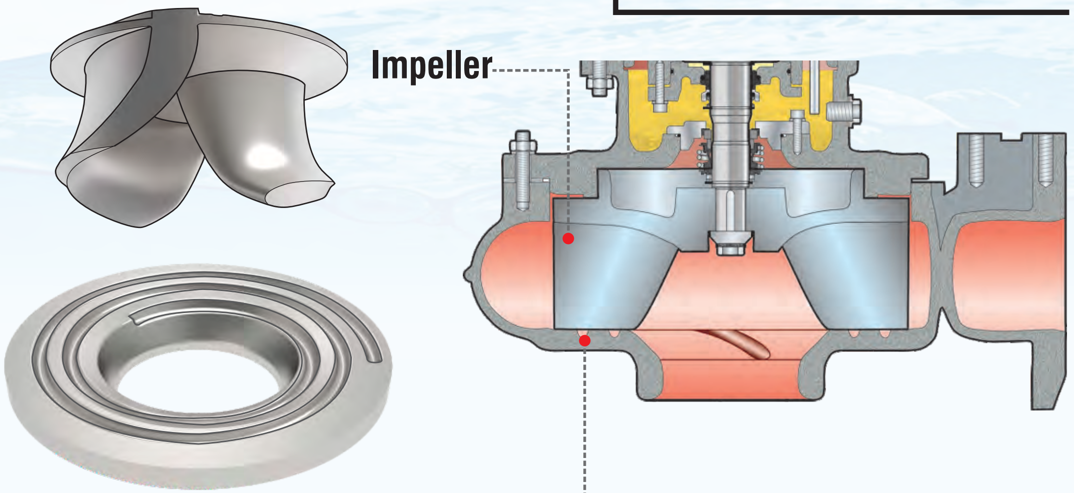
ContraBlock Plus Hydraulics : The **"Gold Standard"** of Sewage pumping for Indian conditions - **Optimal Non Clogging x High Efficiency x Steep Head Discharge Curves**

Semi-Open Impellers with a Blunt & Sloped Inlet Edge, Running against Spiral Cutting & Self Cleaning Grooves ensure that Fibrous Stringy Wastes are either Cut or Swept Away instead of Clogging the Inlet Edge. Large Passages ensure that even Large Solids can Pass Through without Clogging

Macerating *(Cutting/ Shearing)* Inlet Bell Mouth edges



Self Cleaning & Cutting Spiral Groove : Centrifugally "sweeps" blockage causing fibres away from Impeller Casing Cover to Discharge Nozzle thereby keeping the pump clog free



Self Cleaning & Cutting Suction Face

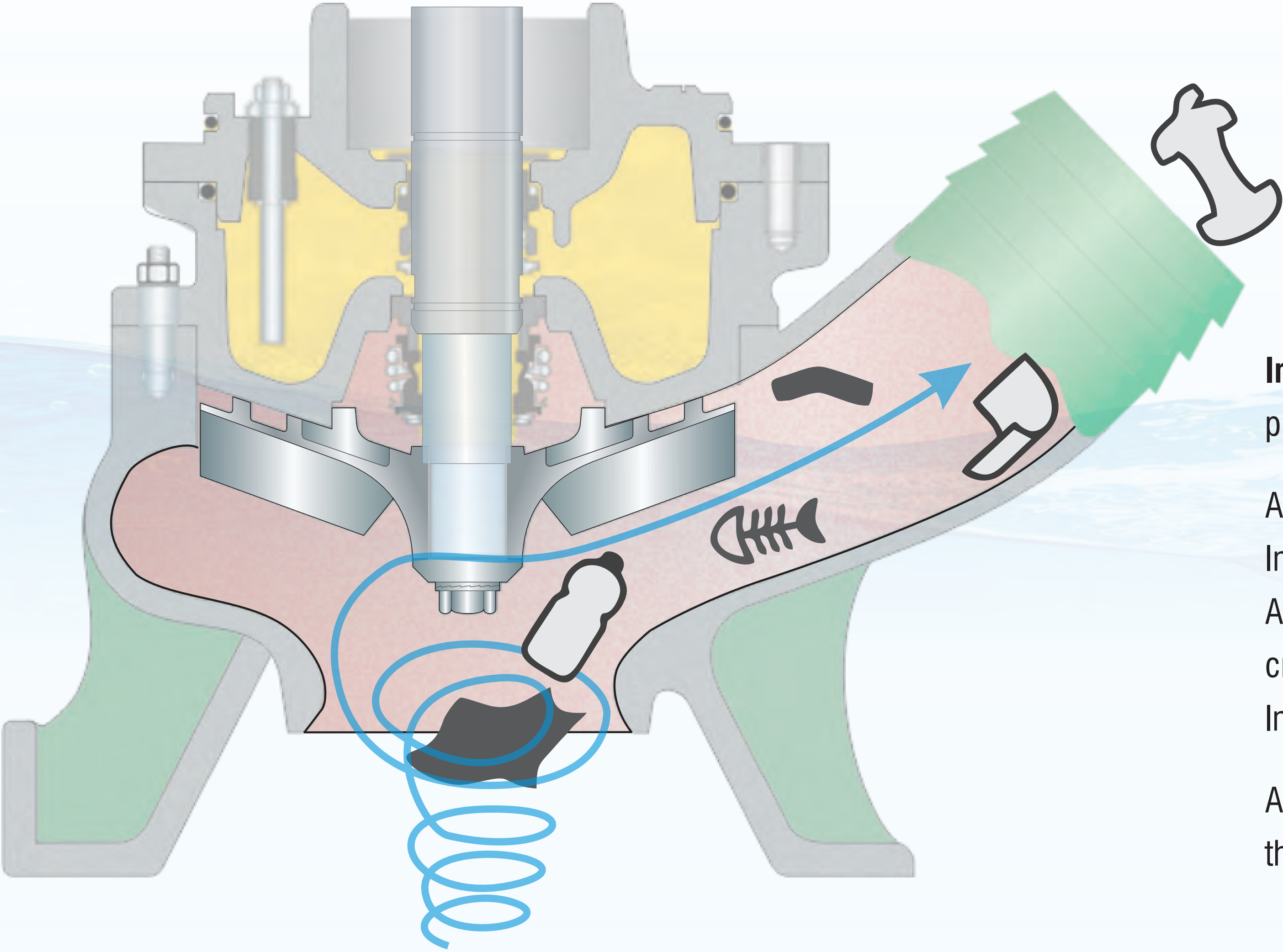
Solution : Aqua's Vortex Hydraulics

Truly Non Clogging...

...Handles Solids & Sludge

Raw Unscreened Sewage

Sludge



Impeller is the most Clog Prone component while pumping Solids.

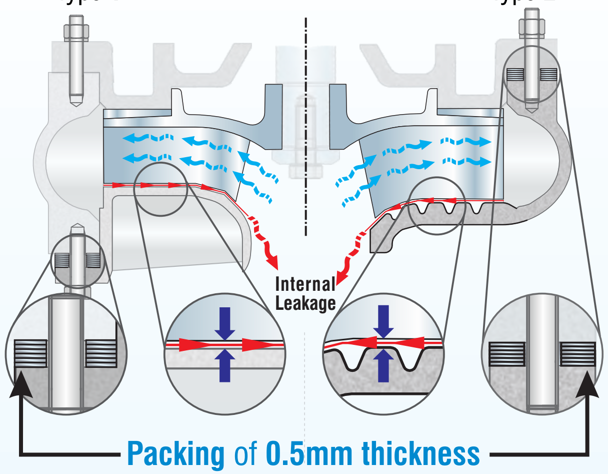
As opposed to "Conventional Non Clog Channel" Impellers *(wherein Solids Pass **Through** the Impeller)*; Aqua's Short Heighted, Open Bladed **Vortex** Impeller creates a ***"Tornado"*** wherein Liquid Touches the Impeller **but Solids Pass from Below the Impeller**.

As Solids Do Not Pass Through the Impeller; hence they **cannot Clog** the Impeller.

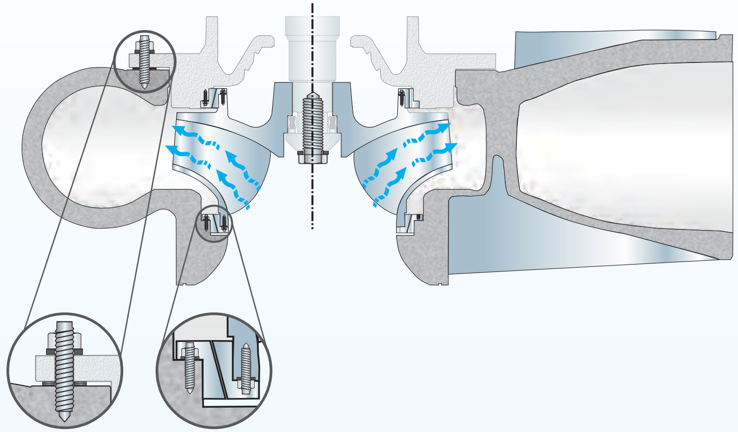
SmartSet Hydraulics : Maintain Peak Pump Perfomance

New Pump

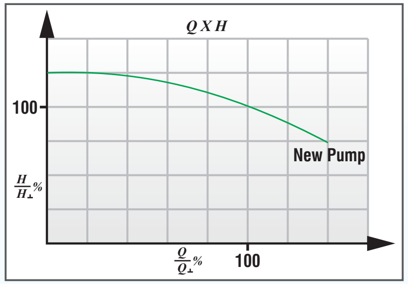
Semi Open Impeller

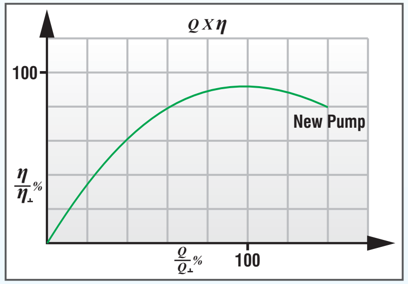


Enclosed Impeller



@ 1000 lpm Design Flow, Actual Flow ~990 lpm will received due to minor leakage.

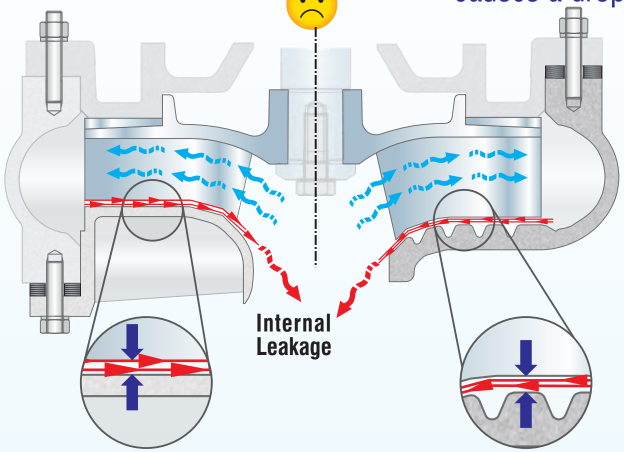


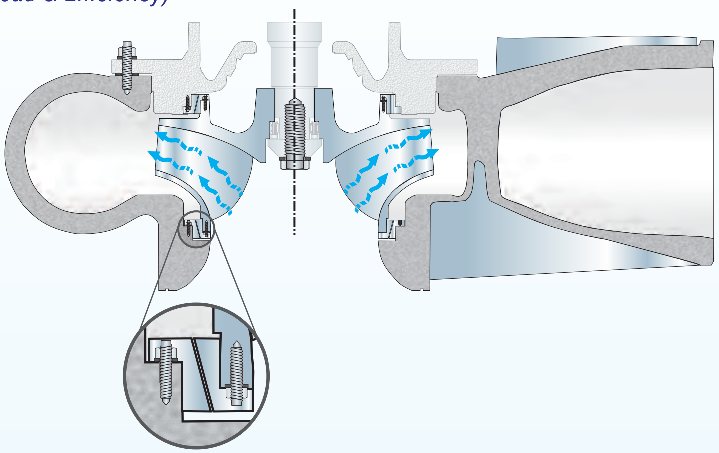


Efficiency of any pump **depends** to **a great extent to Reducing it's Internal Leakages** ( ) which in **turn relies** on the **Close Clearances of the Leakage Gap** ( ) *(between the rotating Impeller & static Casing)*.

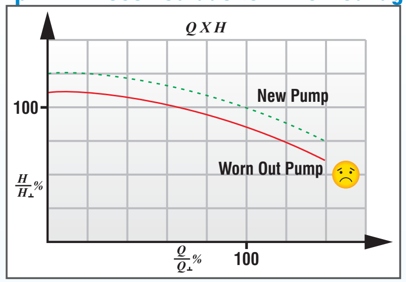
Worn Out Pump *(Increased Clearance due to wear after operation of few years)*

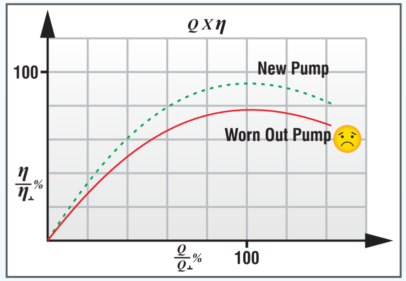
Increased Clearance of Leakage Gap
causes a drop in pump's output *(Head & Efficiency)*





@ 1000 lpm Design Flow, Actual Flow ~930 lpm will received due to minor leakage.

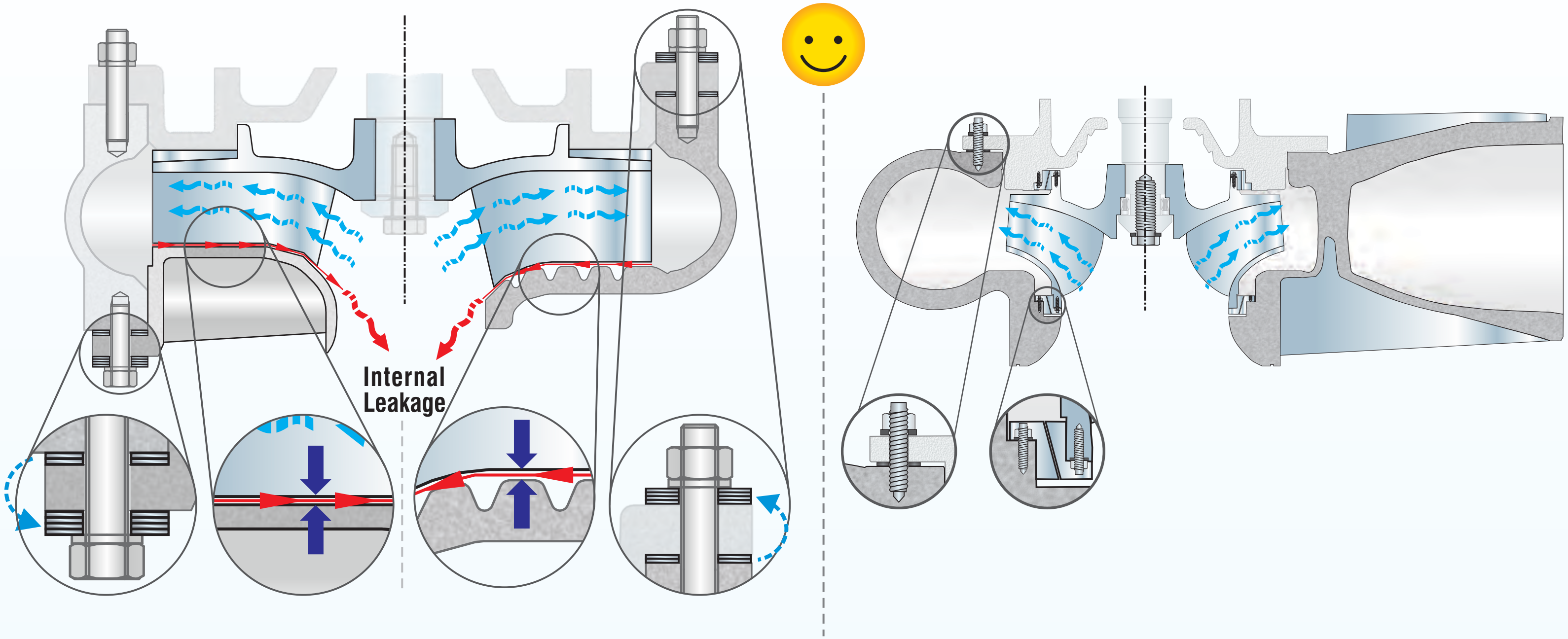




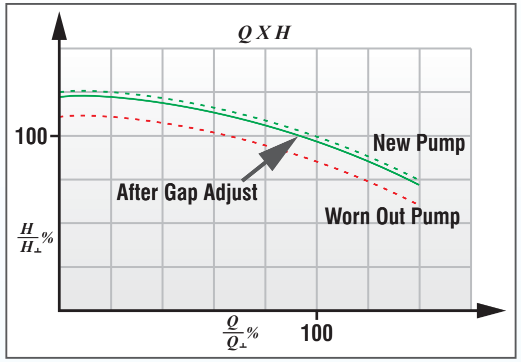
When **Pumps Wear** & **Erode** *(especially due to erosion in presence of silt, grit)*; this **Leakage Gap increases drastically**, which in-turn **unfortunately** increases the **pump's Internal Leakage** ( ) & **thus** hence **Reduces the pump's Efficiency.**

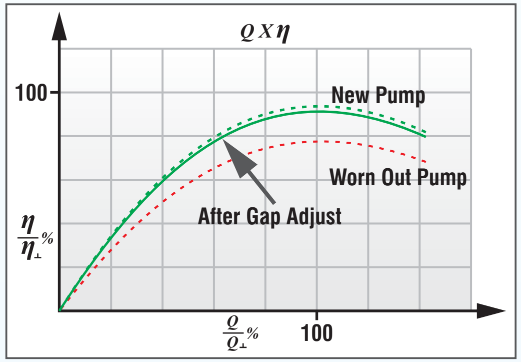
SmartSet Hydraulics : Maintain Peak Pump Perfomance

Aqua's "**SmartSet**" Hydrualic Design; **Impeller-Casing Gap Adjustment system**; Clearance can be Restored



@ 1000 lpm Design Flow, Actual Flow ~980 lpm will received due to minor leakage.





To **restore** the **pump's efficiency,** the **Client will have to reduce the Leakage Gap.** *(As near to the original gap)*

In **Conventional / Competing Pumps,** a **Radial direction Cylindrical Gap is used.** Hence, whenever this **Gap increases,** there is no alternate but to **Replace** the **Wearing Rings** *(a costly & time consuming affair)* **to restore the Leakage Gap.**

However, to **mitigate increased grit** & **silt content** *(in Indian conditions)*; Aqua's **pumpset*** are **equipped with a Unique Impeller - Casing Gap Clearance** in the **Axial direction.**

a) Hence, they are **equipped** with a **method of Restoring the Impeller - Casing Gap's Leakage Clearance** *(as it in the axial direction)* by **simply changing** over the position of packing shims.

b) This **allows** the Client to **restore the pump's efficiency** at site, **without** the **need of frequent buying** of **costly** spare **wearing rings.**

*Conical Wearing Rings may not be available for all models

1. The Goal of Engineers is to have Least Stoppages due to Clogging & Least Energy Costs THROUGHOUT the Flow Chain of Sewage/ Storm Water – i.e. Right from its Primary Collection *(i.e. UGD Lifting Stations, Intermediate PS)* to Treatment *(STPs)* to Disposal. Excessive Focus to Select Ultra High Efficiency pumps *(some of which may also be More Clog Prone)* at Each & Every Stage, may infact Invite Severe Clogging Problems later on in the O&M phase…!

   1.1. As the Nature & Content of Solids, the Key Concerns of Pumping; Change throughout the Flow Chain; there is No Single "Universal" definition of "Non Clog" pump. For e.g. :

      1.1.1 During the Initial stages of the Flow Chain, Smaller Flows but Un-Screened Sewage would be expected in UGD IPS – Robust, Stoppage Free Non Clog performance is the Prime concern in such cases even if it calls for sacrificing a little efficiency.

      1.1.2 While, in the Middle stages of the Flow Chain *(say ISPS or TSPs of STP)*, Medium Flows with Reasonable Screening can be expected – Optimized Energy Efficiency with Non Clog performance will be the Prime concern.

      1.1.3 In the Later stages of the Flow Chain *(say Treated Waste Water of STP)*, Large Flows with Little Solids can be expected – here, the Engineer should Prioritize Energy Efficiency over Non Clog performance to Offset the Increased Energy Consumption Incurred in the UGD/ ISPS earlier in the Initial Flow Chain.

2. By Changing Priorities as per the Exact Solid Size, Solid Content, Solid Nature, Viscosity & pH of Liquid, etc the Designer can Achieve Optimal – i.e. Least Overall Energy Consumption & Highest Non Clog Reliability.

This requires Experience & a Huge Range of Hydraulic Designs,…

…Aqua can help you achieve this goal.