Technology Report – Hybrid Blower Applications and Marketing

Vision Equipment

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PRESENTED TO:

To:
All VE Offices

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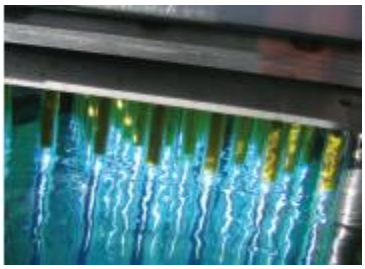

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To: All VE Offices

Subject: Understanding “Hybrid” Blowers

Cliff Notes – The “Hybrid” blower is a marketing term. Hybrid refers to two different types of positive displacement (PD) blowers. Those two types are the screw impeller and the twisted trilobe impeller PD blowers. The purpose of this tech memo is to illustrate the differences and define the proper application range of each.

The best feature of both types of blowers is that they do not surge.

The final section compares traditional Hybrid Twisted Trilobe verses Screw Hybrid, then both of those versus APG Neuros Turbo blowers. It will be shown that screw type hybrid blowers have a very limited position in the marketplace.

This Tech memo was written with support from United Blower who offers both the straight Trilobe PD and the Screw type Hybrid PD. Technical support for the Turbo blower documentation was provided by APG Neuros. .

Hybrid Blower Basics

The first step when discussing “hybrid” blower technology is to determine which hybrid blower technology is being discussed. The term “Hybrid” can apply to either Trilobe PD or Screw type PD blowers. The application should be the determining factor for the technology selection. Each type serves very different applications. Both have a place in the market when properly applied.

The Trilobe Hybrid PD incorporates a twisted impeller design whereas the traditional trilobe blower has straight impellers. If the straight trilobe impeller design is selected, then pulse control is required. The purpose of the “twisting” of the impeller is to reduce pulsations. The performance is identical between the two configurations.

Discharge Pressure Determines the Hybrid Approach

Screw Impeller Hybrid - Screw impeller PD blowers utilize an internal compression stage combined with much higher RPMs to produce efficiency at higher discharge pressures than achievable from both types of trilobe PD blowers. The application of an internal compression stage in PD blowers is relatively new though internal compressors are old and proven technology by themselves. The screw blower however remains new to the marketplace with few operating machines.

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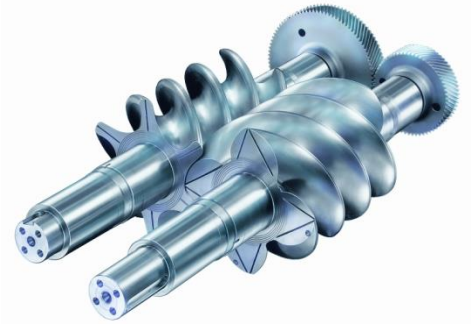
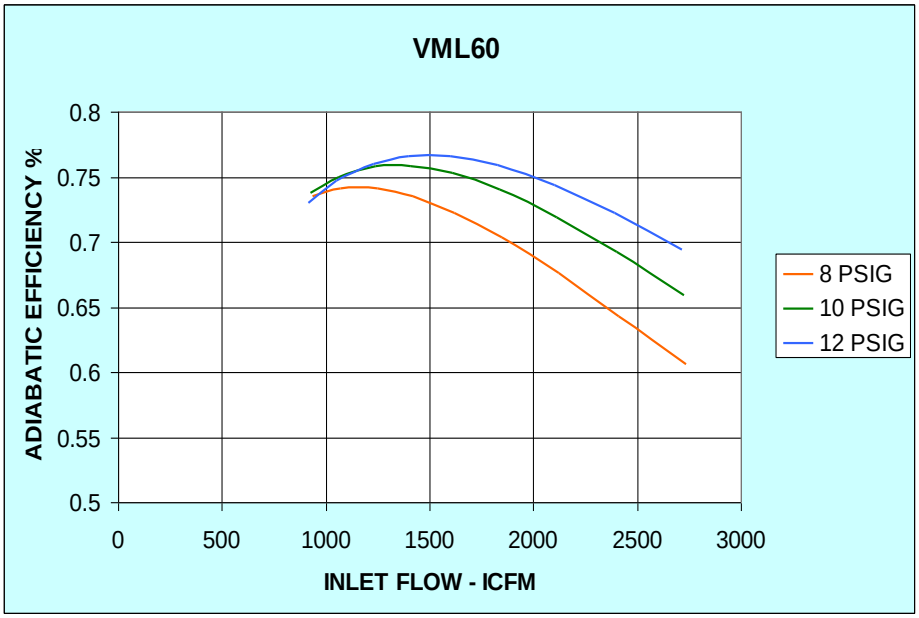


The above graphic is of a typical screw blower impeller.

Screw impeller hybrid PD blowers are well suited for high discharge pressure applications. High discharge pressure applications are those that have a minimum discharge pressure of 10 psig but may go as high as 30 psig.

Ingersoll Rand/UBI with five single stage blower sizes and twenty (20) gear configurations can optimize their screw blower to operate at the lower discharge pressures with good efficiency at the expense of losing their ability to operate at the higher discharge pressures. A good application for this type of blower is a deep (20' +) constant level basin at high altitude, or a similar process with abnormally high pressure loses in the piping arrangement.



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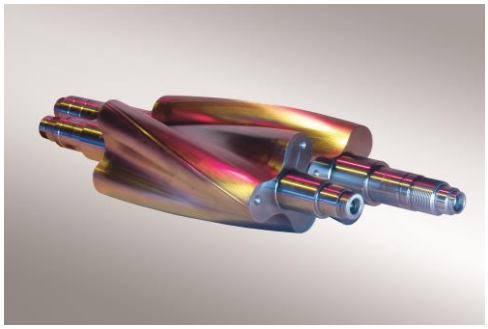
Limitations of the screw impeller approach are shown in the graph above. The screw impeller configuration begins to enter its range of efficiency at an approximate 10 psig discharge pressure. Few WWTP applications are in this range on average.

Traditional and Twisted Trilobes – Twisted and straight trilobe PD Blowers utilize the well proven trilobe configuration. Both configurations are well suited for the full range of low discharge pressure applications. The trilobe works well from 0 psig up to 15 psig. The purpose of the "twisted impeller" is to smooth out the pressure pulsations inherent with a PD blower.

The following graphics details the air flow through the straight trilobe configuration on the left and the twisted trilobe on the right. It should be noted that a straight trilobe hybrid with pulse control offers identical performance to a twisted trilobe hybrid.

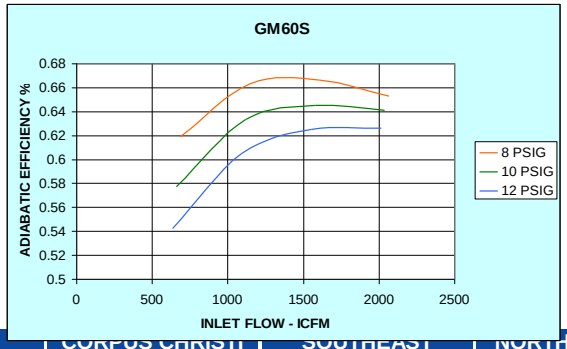
Straight Trilobe



Twisted Trilobe

The following curve accurately defines the twisted trilobe's hybrid performance curves. The twisted trilobe or straight trilobe with pulse control is well suited for operating at lower psig discharge pressures. An excellent WWTP application for this PD blower configuration is a conventional SBR.

The twisted or straight trilobe hybrid blower is limited at lower flows and is less efficient at the higher pressures.



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Twisted Impeller hybrid technology is simple. It is the latest evolution of the conventional trilobe PD blower. It is robust, well proven and the twisted lobe smooths out the pulsations in the flow. Additional operator satisfaction, optimization and performance will be gained from the use of modern controls like the VFD and PLC.

The low speed nature of the twisted trilobe hybrid blower does not require bearing temperature monitoring so the PLC is not required.

Comparing Screw type hybrid PD blowers to Trilobe hybrid PD Blowers

Design Basis:
Case 1 – Blower systems operating at *HI* constant discharge pressures (12 + psig) at variable air flows. Deep aeration basins with a minimum of water depth fluctuations meet this case, for example. A VFD is required for this application.
Case 2 – Blowers systems operating at *LO* constant discharge pressure (8 or less psig) at variable airflow. Shallow aeration basins with a minimum of water depth fluctuations meet this case. A VFD is required.
Case 3 – Blower systems operating at variable discharge pressures (12-4 psig) at constantly fluctuating water depths. An SBR would be an example of this case. A VFD is required.

Results:
Specific design points can generate specific results but, in general, the following holds true.

- At high discharge pressures (12 + psig) at constant RPM screw hybrid blowers are more efficient than either types of trilobe PD blowers.
- At lower discharge pressures (below 10 psig) at constant RPM straight and twisted trilobe hybrid PDs are more efficient than screw type hybrids.
- At variable discharge pressures (12-4 psig) the average psig must be considered to determine the most efficient approach.
- When discharge pressure and airflow varies the correct blower selection becomes complicated and requires precise input from the design team concerning how much time is spent at each design point.

Comparing Screw type Hybrid Blowers to Tier 1 Turbo Blowers

Several manufacturers are attempting market screw type hybrid blowers into traditional Tier 1 Turbo Blower applications. For this reason we need to compare the two approaches.

Screw impeller PD blowers operate at 5,500-7,500 RPMs. This represents a true middle ground in terms of RPM range as the trilobe PD operates around 2500 RPMs while the Tier 1 Turbo performs at approximately 18,000 RPMs. Screw impeller blower technology is considered to be high speed rotating equipment. High speed rotating equipment requires special bearings and bearing lubrication. Field experience proves a forced oil lubrication approach is required. Screw impeller designs utilizing splash lubricated bearings should be

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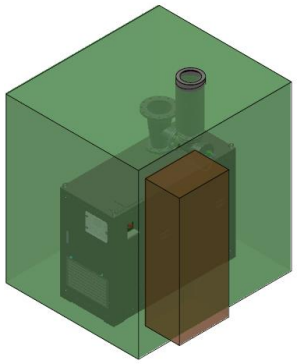
avoided. Lastly, it should be noted that Tier 1 Turbo blower technology and even the lesser performing turbo blowers like Aerzen, HSI and ABS gained their performance advantage by largely eliminating the drag and friction of conventional bearings. It stands to reason that when a comprehensive “wire to air” analysis is completed on screw impeller hybrid PD technology it likely will fall well short of efficiencies typically offered today. Bearing temperatures should be monitored with real time adjustments. PLCs are required. CPUs will collect the data but are limited in processing and distribution of real time data. CPUs are of no value when real time process adjustment is required. If they could, then PLCs would not exist for this application.

Footprint Comparison

The APG Neuros is the most compact of all high efficiency blowers. Twisted Trilobe PD blowers require about 25% more floor space while screw impeller blowers require about twice as much floor space as an APG Neuros Turbo blower.



The above graphic shows a 150 HP screw blower (green box) superimposed over a 150 HP APG Turbo Blower.

Noise Comparison

Screw Blowers are similar in noise to multistage or conventional PD blowers. Twisted trilobe are better while the least intrusive noise is produced by the APG Neuros package. The APG Neuros is quite by technology, no sound attenuating enclosure is required. The twisted trilobe requires a sound attenuating enclosure.

Controls Comparison

Screw Blowers require VFDs. Some manufacturers are still sorting out the sourcing of their VFDs. One manufacturer builds their own in Korea while others manufacturers leave them to the contractor for sourcing. Ingersoll-Rand/United Blower source their VFDs from standard US manufacturers and are included with the package.

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(Pictured above is the Korean shop built Aerzen VFD on a 100 HP Screw Hybrid)

The APG Neuros standard control configuration is complete with a AB PLC and HMI with full bearing temperature and vibration monitoring. Furthermore, VPN connection allows for real time monitoring and adjustments from APG remote operations surveillance center.

Price Comparison
Based on bids in Texas the market price of a screw impeller hybrid PD blower is about the same as the APG Neuros.

However, if the same manufacturer, Aerzen for example, offers a Tier 2 Turbo blower with a proven lesser efficiency rating than the Tier 1 Turbo Blower then it very well may make sense for Tier 2 Turbo Blower supplier to try to switch the buyer's attention to a hybrid screw type PD technology. If the performance is similar between a Tier 2 Turbo Blower and a screw type hybrid is it likely the screw type PD will be more reliable.

Please note, when a consumer senses "the bait and switch" (from Tier 2 Turbo to Hydrid) is being offered the application must be critically re-considered because most WWTP applications require an average discharge pressure of less than 10 psig. When that is considered it is highly likely the trilobe hybrid PD will outperform the screw type hybrid.

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Comparison Chart

Brand	Blower Type	Best PSIG	Efficiency	RPM (+-)	dBA (+-3)	Controls	Cost (150 HP)
APG	T1 Turbo	3-15	Base	18,000	80	VFD, PLC	Base
Aerzen	T2 Turbo	9-11	-15 to 25%	22,000	85	CPU/VFD	- 40%
IR-UBI	Screw PD Hybrid	7-15	-15 to 25%	5500	82-85	VFD/PLC	= APG
Aerzen	Screw PD Hybrid	7-15	-15 to 25%	7500	82-85	VFD/CPU Optional PLC	= APG
Kaeser	Screw PD Hybrid	7-15	-15 to 25%	7500	82-85	VFD/PLC	= APG
UBI	Twisted TriLobe PD Hybrid	3-7	-35%	2500	78	VFD/PLC Optional	- 50%
Aerzen	Twisted TriLobe PD Hybrid	3-7	-35%	2500	78	Optional VFD/PLC	- 50%

Direct Application Comparison Hybrid PD Vs APG Turbo Blower

Vision Equipment recently took the liberty to compare all three blower types for an SBR application here in Texas. Each Manufacturer provided the details reported below.

Design Basis:

Application…….....4 Basin Conventional SBR
Elevation…… 735’ elevation
Inlet Temp……..110ºF
SCFM Capacity……..…2000
Required HP/Unit with VFD Control……..150
Maximum Discharge Pressure……..12.69 psig
Operating Pressure Range……...…….8-13 psig
Max Basin Water Depth…….23.7’
Average Water Depth……....18.7’
Pipe Lose (estimate)……2.5 psig

Airflow (SCFM)			1098	1223	1390	1522	1658	1765
Manufacturer	Type							
APG Neuros	Turbo	BHP	71	77.7	87	94.7	103.2	110.1
		Tolerance: +- 5% on Power and +- 5% On Flow						
PD	screw	BHP	82.9	94.1	110.4	124.5	139.6	152.5
PD	Twisted Trilobe	BHP	94.2	101.6	111.4	119.3	126.2	133.8

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Conclusions

a). The APG Neuros Turbo Blower saves power under all conditions.
b). The screw blower is more efficient than the twisted trilobe at the lower airflows.
c). The straight and twisted Trilobe PD blower is more efficient than the screw blower at higher airflows.

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