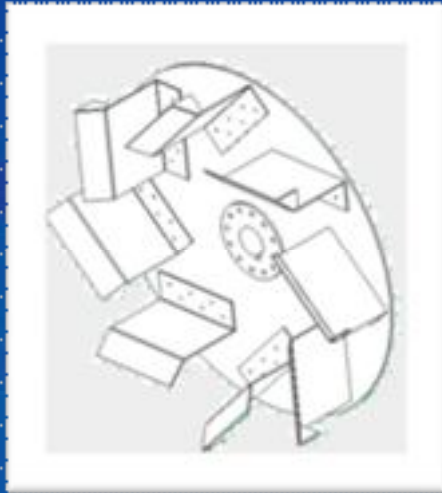




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# Wastewater Treatment Plant Energy Reduction With High Efficiency Aerators

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m2t technologies

# OBJECTIVE

TO PRESENT HIGH EFFICIENCY AERATORS THAT WILL  
REDUCE ENERGY CONSUMPTION IN WASTEWATER  
TREATMENT PLANTS, BASED ON EXPERIENCE AT THE  
DHAHRAN NORTH SEWAGE TREATMENT PLANT  
(NSTP)

# OUTLINE

- **BACKGROUND**
- **EVALUATION**
- **HIGHER MECHANICAL AERATOR EFFICIENCY**
- **DHAHRAN NSTP PROJECT**
- **CONCLUSION**

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# Dhahran NSTP Overview

## DHAHRAN NORTH SEWAGE TREATMENT PLANT



## SECONDARY BIOLOGICAL TREATMENT

## DHAHRAN ADVANCED WASTEWATER TREATMENT PLANT



## TERTIARY-FILTRATION TREATMENT

# EXISTING AERATORS LOW EFFICIENCY





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# Energy Efficient Aeration Alternatives

Fine Bubble Diffusers





High Efficiency  
Mechanical Aerators





# Energy Efficient Aeration Alternatives

SYSTEM TYPE	FINE BUBBLE DIFFUSERS 	HIGH EFFICIENCY MECHANICAL AERATORS 
CAPITAL AND MAINTENANCE ITEMS	Blower Building, Blowers, Air Filter System, Sound Enclosures, Air Piping System, Diffusers.	Motor, Gearbox, Impeller, and Aerator Platforms.
BIOFOULING	Biofouling sometimes reduces efficiency. Acid Cleaning Sometimes Required.	None.
ENERGY EFFICIENCY	High	High
ESTIMATED CAPITAL COST	More Expensive	Less Expensive

# ESTIMATED ELECTRIC POWER COSTS

AERATOR	O <sub>2</sub> TRANSFER LB O <sub>2</sub> /HP·HR	POWER USD/YEAR	SAVINGS USD/YEAR
TYPICAL MECHANICAL AERATORS	2.5	\$146,000	0
HIGH EFFICIENCY MECHANICAL AERATORS	3.5	\$88,000	\$58,000

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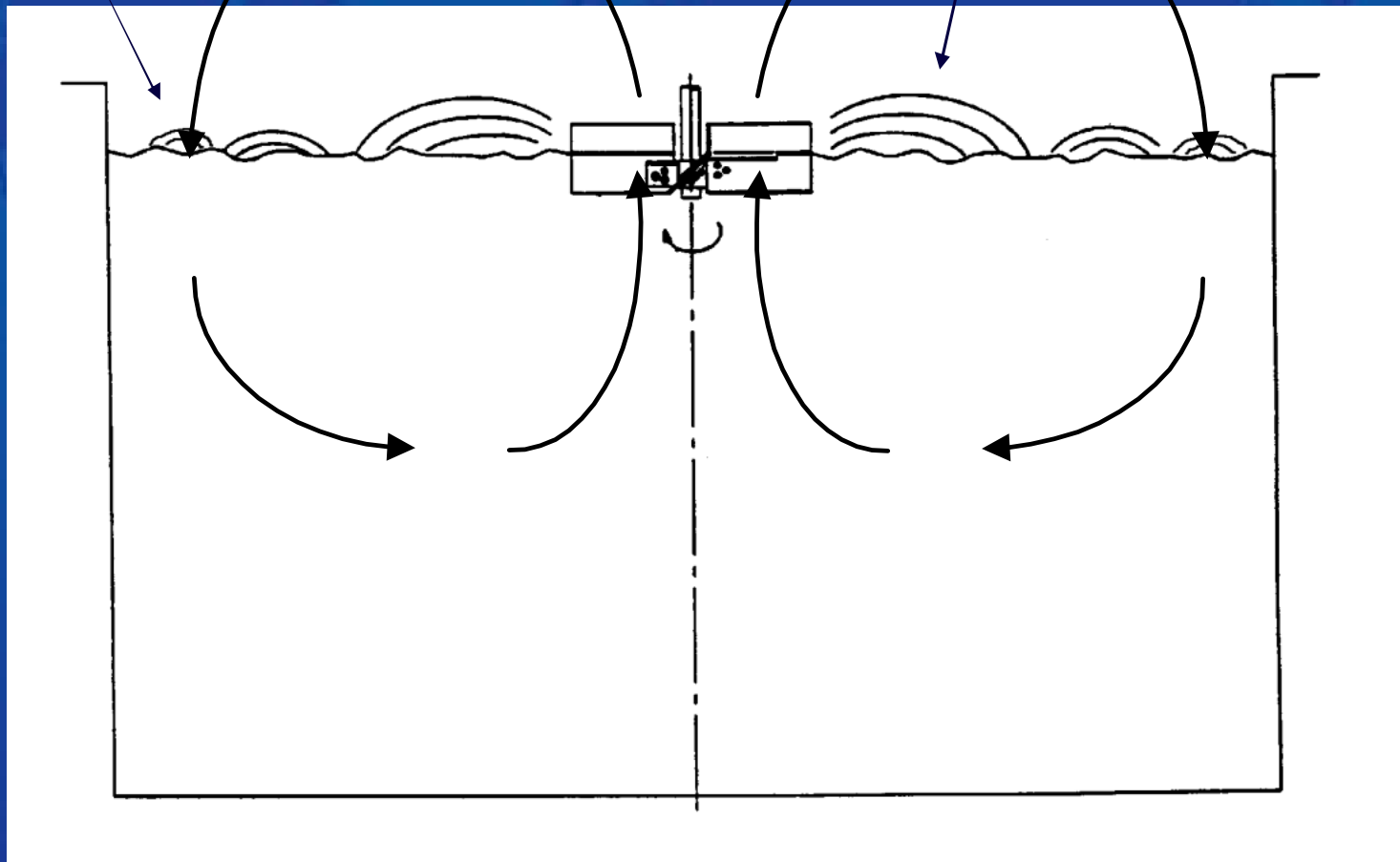
# Fundamentals of Surface Aeration

- Surface Aeration is a distinct two-step process consisting of the “Spray Zone” and the “Re-Aeration Zone.”
- Approximately 66% of the mass transfer occurs in the “Re-Aeration Zone.”
- The “Re-Aeration Zone” is enhanced by fluid volume and higher pumping rates through the surface aerator.
- Novel system configurations can optimize the performance of both the “Spray” and “Re-Aeration” zones.

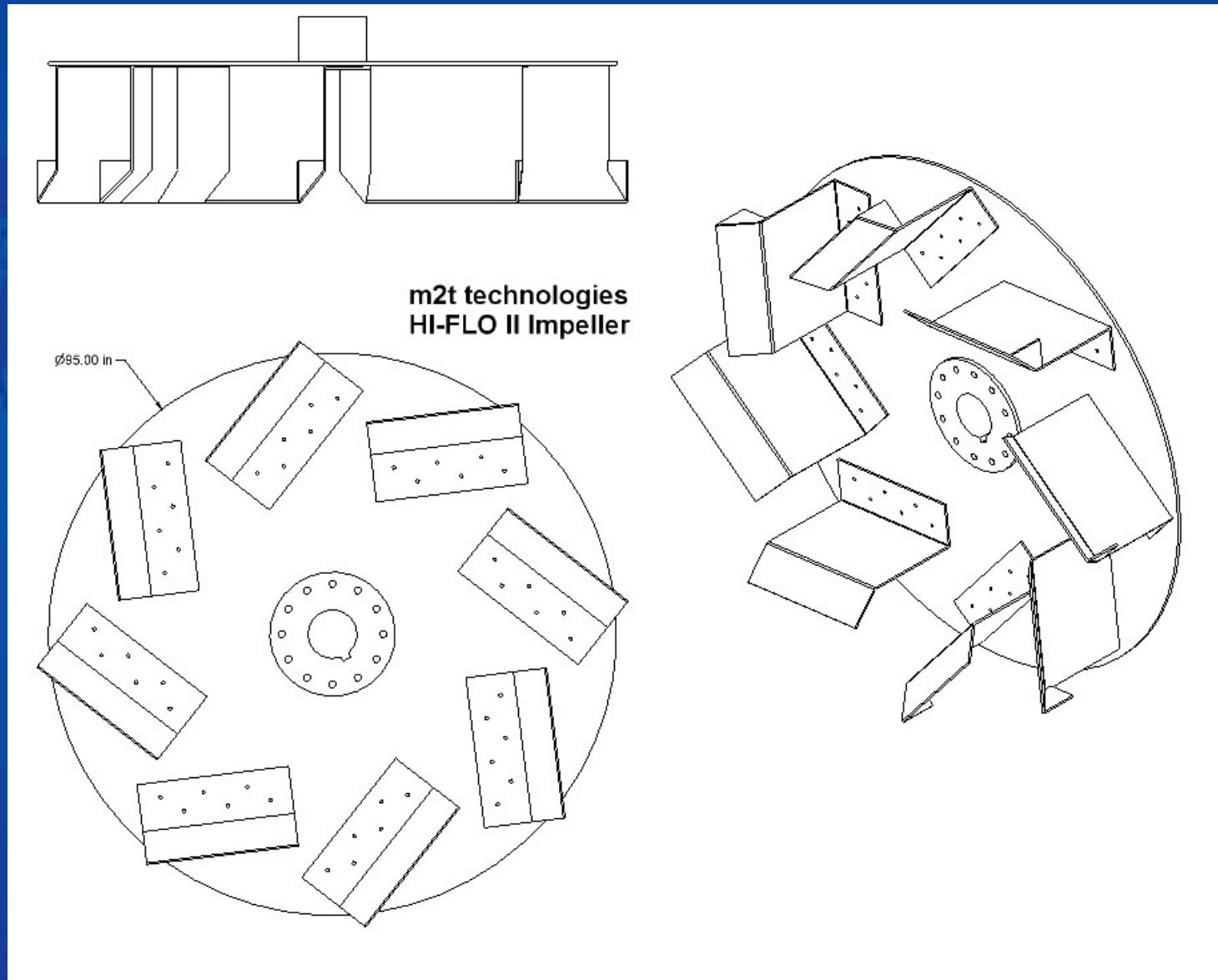
# Surface Aeration System Oxygen Transfer Characteristics

Surface Re-aeration  
Mass Transfer Zone

Spray Mass  
Transfer Zone



# HI-FLO Surface Aeration System Impeller



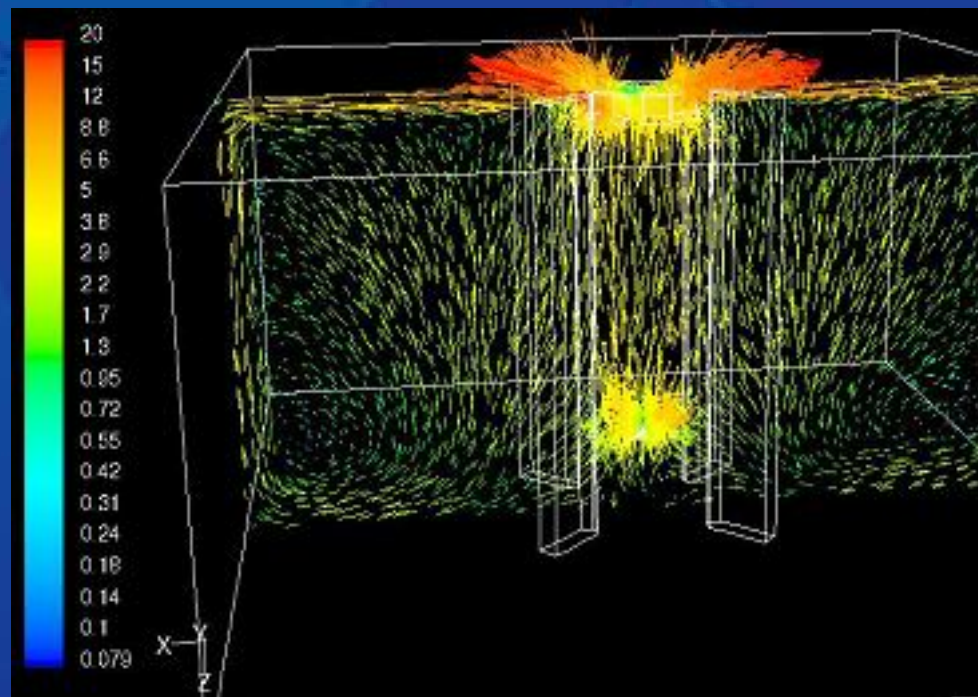


# m<sup>2</sup>t technologies Process Modeling

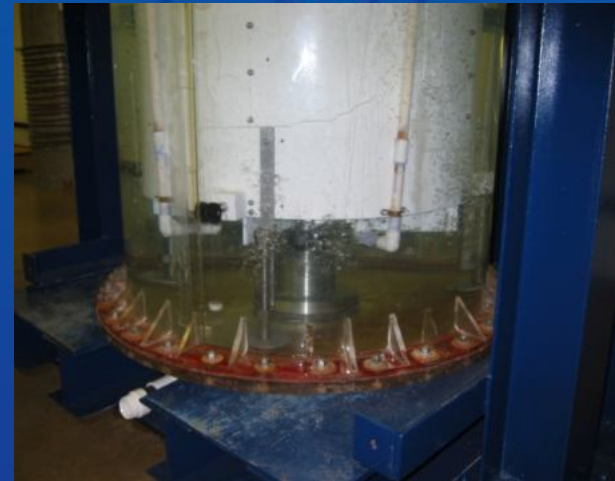
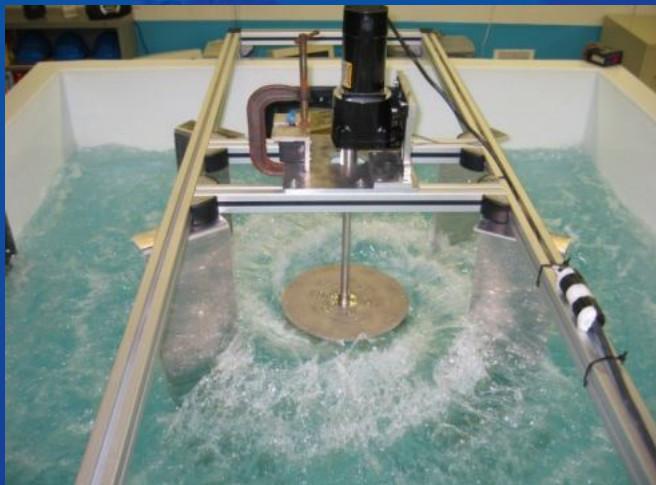
## Computational Fluid Dynamics (CFD)

Rigorous fluid dynamics simulation provides fundamental mixing insight

- Detailed impeller geometry used
  - Sliding-mesh model for impellers
- No experimental velocity data used as input
- Solve turbulent Navier-Stokes equations to obtain flow field



# Technology Development Facilities State College, PA., USA



# m<sup>2</sup>t technologies Full Scale Aeration Test Facility



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# Dhahran NSTP Plant Overview





# Construction of New Aeration Basins





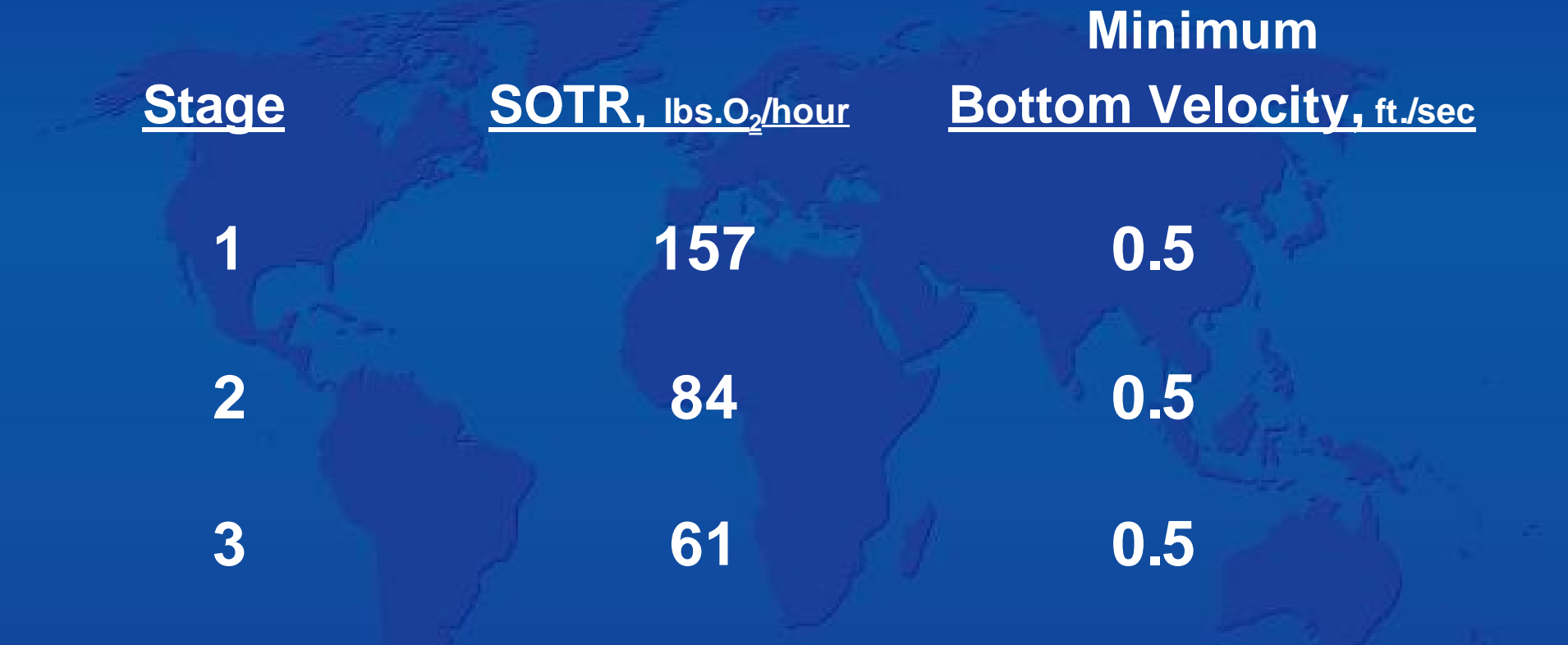
# Aeration Platform Elevation Check



# HI-FLO Aerator Impeller Installation



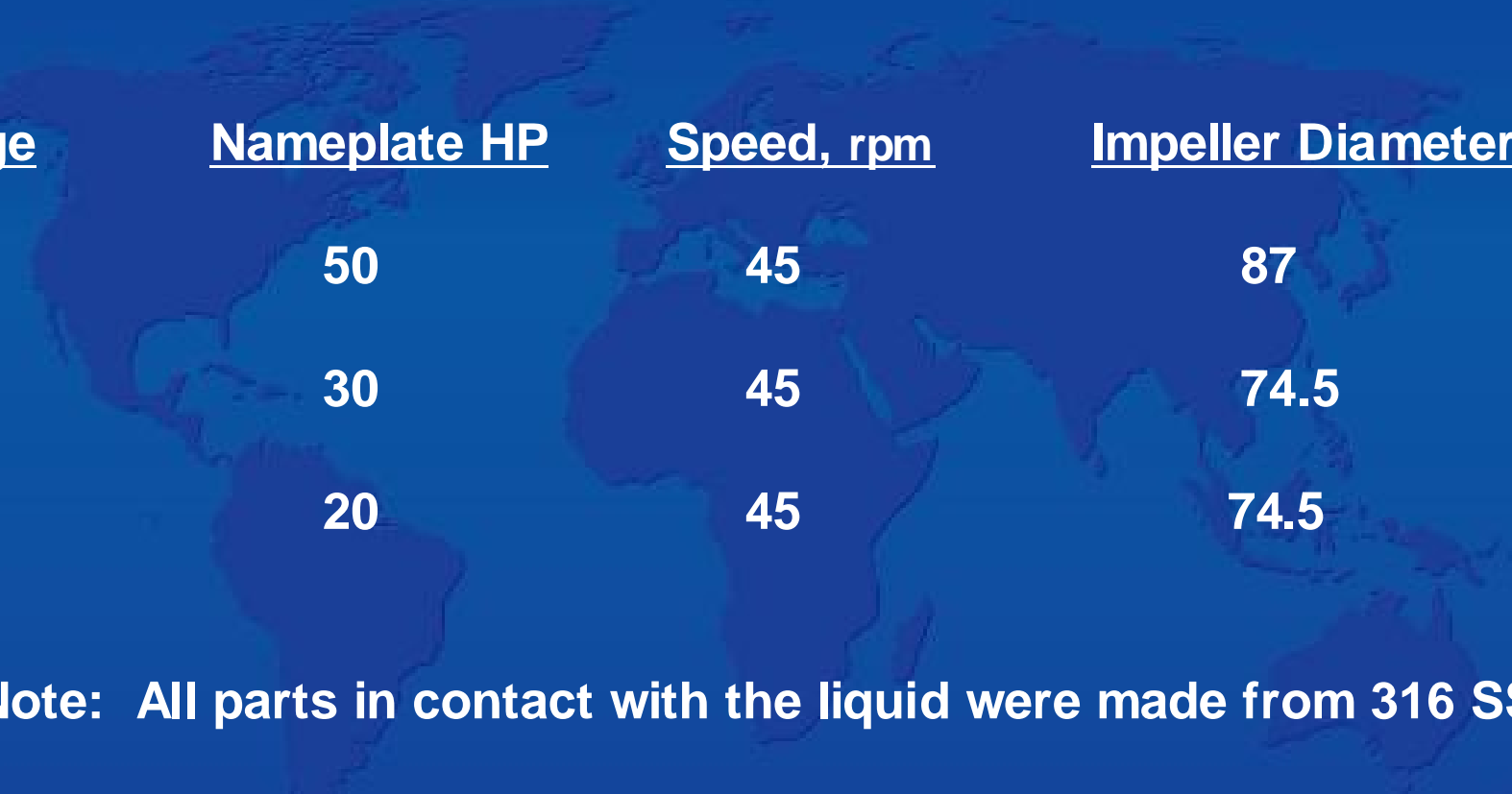
# Dhahran Aeration System Process Requirements



<u>Stage</u>	<u>SOTR, lbs.O<sub>2</sub>/hour</u>	<u>Minimum Bottom Velocity, ft./sec</u>
1	157	0.5
2	84	0.5
3	61	0.5

Required Train Average Standard Aeration Efficiency (“SAE”) of 3.5 lbs. O<sub>2</sub>/BHP-hr

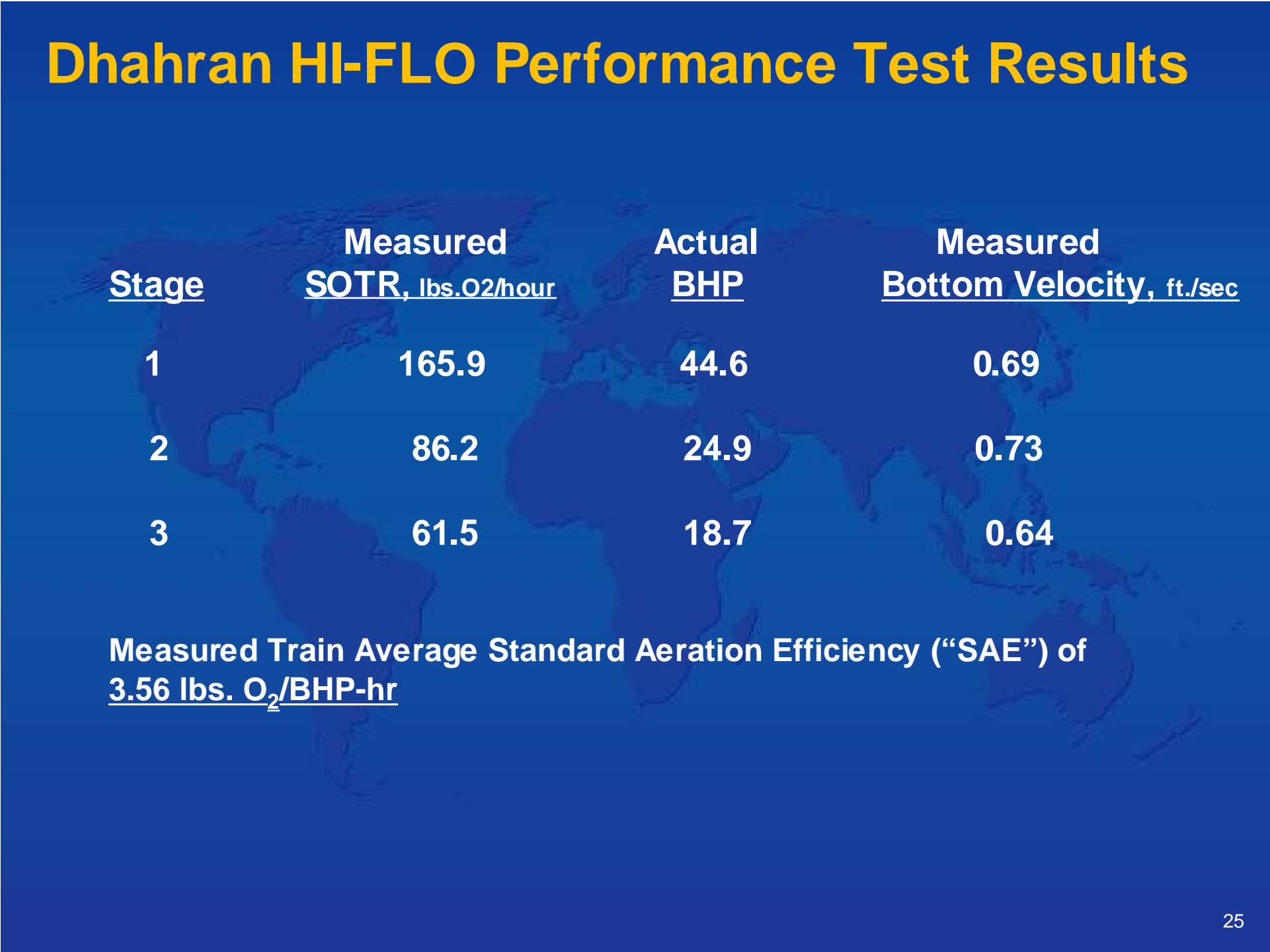
# HI-FLO Surface Aeration Design Configuration

A faint world map is visible in the background of the slide, centered behind the table.

<u>Stage</u>	<u>Nameplate HP</u>	<u>Speed, rpm</u>	<u>Impeller Diameter, in.</u>
1	50	45	87
2	30	45	74.5
3	20	45	74.5

**Note: All parts in contact with the liquid were made from 316 SS**

# Dhahran HI-FLO Performance Test Results



<u>Stage</u>	<u>Measured SOTR, lbs.O<sub>2</sub>/hour</u>	<u>Actual BHP</u>	<u>Measured Bottom Velocity, ft./sec</u>
1	165.9	44.6	0.69
2	86.2	24.9	0.73
3	61.5	18.7	0.64

Measured Train Average Standard Aeration Efficiency (“SAE”) of 3.56 lbs. O<sub>2</sub>/BHP-hr



# HI-FLO Surface Aerator in Operation





# OLD AERATORS



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# CONCLUSIONS

- HIGH EFFICIENCY MECHANICAL AERATORS ARE LOW MAINTENANCE COMPARED TO OTHER AERATION SYSTEMS
- HIGH EFFICIENCY MECHANICAL AERATORS REDUCE ENERGY CONSUMPTION



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Thank you