COMPARISON

The InvisiHead Diffuser System

At American Eco Systems, we design, fabricate, and deliver the InvisiHead intake and outfall system. The InvisiHead is a unique diffuser system that is highly efficient and environmentally friendly. It features support legs bolted to the concrete block, riprap rocks laid around the concrete block, and a concrete base block. The intake or outfall pipe can be connected to or from the onshore infrastructure. The InvisiHead Sea Outfall flow attains local ambient conditions as soon as it is out.

The Linear Jet Diffuser Systems

The Linear Jet Diffuser Systems are designed to provide efficient and effective discharge of wastewater, cooling water, and brine. They are heavy concrete bases that safely anchor the InvisiHead to the sea floor. The diffuser jet is directed into the water, creating a strong jet that helps to mix and disperse the water.

The InvisiHead is highly site-specific and velocity selective, making it ideal for a variety of applications. The Linear Jet Diffuser Systems are adaptable to different conditions and can be customized to meet specific requirements.
COMPARISON
The Round Surround Up and Down Multi Plume 3-D Brine Dispersing InvisiHead vs. Linear Jet Diffusers
The following slides show several images of Jet linear diffusers. Effluents need to come under pressure created by pumping energy to create jets and disperse fluids through nozzles like cooling water, RO brine, and wastewater.
Line source, $F=24$, $z/d_F=1.14$

Point source, $F=24$, $z/d_F=11.6$

Figure 3.2: Power field distribution in wind tunnels.
Layout of an outfall pipeline with multiport diffuser
Linear diffusers consume valuable sea space as well as pumping energy to force the fluid through the diffuser spray nozzles spray the fluid over a relatively large area to accomplish the required dilution within 60-75m away from the release point. As shown in this diffuser a RO concentrate of 66,000 ppm is released to be diluted to the required limit of 36,000 ppm at the end of the mixing zone. The InvisiHead achieves that goal at less than 1m away from the release point. Velocity in diffusers has to be high enough to prevent deposition of sludge, grease etc. Use of linear diffusers lead to increased energy use and operating costs in addition to the relatively high capital costs.

For the Gaza RO plant brine TDS would be around 79,000 ppm. The required dilution should be around 25 or about 42,000 ppm reached at about 75-100m away from the discharge jets. Natural seawater is 41,000. The InvisiHead would achieve the required dilution in 1-2m away fro the discharge point. The brine would blend with seawater to a TDS of 41,600 ppm 20m away from the discharge point. Dilution rapidly approaches the natural limit, see the table in the next page.
The InvisiHead slowly releases brine and disperses it in small narrow thin plumes in a round surround up and down fashion, which insures the highest possible contact with the local seawater and produce max dilution within the vicinity of the outfall.

The round surround plume figure in red and the table are produced by the US EPA Visual Plume Model.

Required dilution achieved 0.878m away from the InvisiHead outfall.
4-D Flow: 3 space + 1 time = round surround up sideways & down funneling out

The flow Control Discharge Chamber Gravity outfall

The InvisiHead Sea Outfall; flow attains local ambient conditions as soon as it is out
The O&M-Free InvisiHead Brine Diffuser Gravity Driven System – No pumping

The InvisiHead needs no maintenance or any parts replacement or any costs associated with the O&M process for life

Dispersion is gravity-driven. **No pumping is involved.** The extremely low discharge velocity allows fluids to slowly disperse and reach a high dilution ratio within the vicinity of the diffuser structure. A brine with a TDS of 77,000 ppm would reach the required dilution ratio of about 25 to dilute to 43,000 ppm if the seawater TDS is about 42,000 ppm. This rate of dilution is achieved at about 1 m away from the diffuser. Dilution would reach about a 100 some 12 meters away from the diffuser structure where the TDS would be about 42,350 ppm. A few meters away TDS sensors will record no change in the ambient seawater of the 42,000 ppm. The following two pages demonstrate a similar InvisiHead RO brine discharge performance made at the Atlantic where the ambient TDS is about 37,000 ppm. This brine TDS was 78,820 ppm, nearly same as Gasa’s except for the natural seawater salinity it is 37,000 ppm.
US EPA Visual Plume Model shows the InvisiHead performance to dilute 100,000 m³/d of brine for the Bilmoral RO plant, NW Australia

About 20m away from the source the dilution reaches a 100. Max dilution of 24.97 as per the US EPA regulations is reached at 0.878m away from the discharge point.
US EPA Visual Plume Model shows the InvisiHead performance to dilute 3,923 m³/h of wastewater for the sewage treatment plant in Ontario, Canada.

About 2m away from the source the dilution reaches a 1000; about 50m away it reaches 5183. Max dilution of 171.9 as per the regulations is reached at 0.055m away from the discharge point.

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<th>Depth (m)</th>
<th>Amb-cur (m/s)</th>
<th>P-dia (kg/kg)</th>
<th>Polutnt Dilutn</th>
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Linear Diffuser Operation and Maintenance Economics

An illustrative example

Outfall Cleaning and Diffuser Repair Bid Analysis
Assumptions (based on 2005/2006 work):
1) To remove debris from the pipe interior will take ten (10) 8-hr. work days for a total of 80 hours.
2) To replace the one known missing diffuser will take two 8-hour days allowing for mobilization of the crane for a total of 16 hours.
3) That we will have about a thirty day permitted In-water work window subject to river level and flow. The objective will be to begin the project as late as possible In August allowing for the lowest river level while still having adequate time to complete the entire scope of work. This will require overtime rate.
4) Because of uncertainty of the amount of material in the pipe and the length of time required to remove It a contingency amount of 20% is added.

Estimated Total: $90,420 2011$
$95,575 2015$
Conclusion

The InvisiHead outfall system is a technical and a commercial breakthrough in the intake and outfall seawater Industry. Attaining a certain dilution rate in a given radius around the outfall might be obligatory in order to meet mixing zone regulations. Technically it meets and exceeds environmental requirement and achieves high dilution ratio in just a short distance from the brine outlet. It protects the environment since it inflicts no adverse impact on the ambient. The InvisiHead diffuser system involve no human or machine interference to operate it or maintain it. The technology is O&M-free

Commercially, the InvisiHead diffuser system is lower in costs to buy. No costs are involved neither with its operation nor with its maintenance. The money spent in running other diffuser systems can be saved in the case of the InvisiHead. The savings pay back the money spent to buy the system. The payback period in this case is about 3 years.