FLUIDYNE
CORPORATION

THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY

# ISAM™

## SEQUENCING BATCH REACTOR PROCESS

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## TRUST FLUIDYNE'S EXPERIENCE

The Fluidyne ISAM™ Sequencing Batch Reactor (SBR) system incorporates the latest and most innovative technology and over three decades of experience in providing the most reliable SBR systems with the highest effluent quality. Fluidyne SBR systems are in operation around the World and have won numerous awards. Fluidyne SBRs consistently provide better than 10/10/5/1 (BOD5/TSS/TN/TP) effluent quality. Fluidyne engineers have designed over 500 SBRs, and been granted over twenty patents.

## A TOTALLY NEW CONCEPT IN SBR DESIGN

The Fluidyne ISAM™ Sequencing Batch Reactor system is a single train SBR system which incorporates a constant level anaerobic selector chamber, followed by a surge/anoxic/mix (SAM™) tank , and one or more SBR basins.

In operation, all influent flow enters the anaerobic selector chamber where influent solids are allowed to settle much like a primary clarifier. Elimination of primary solids in the anaerobic chamber allows for much smaller SBR basins at an equivalent SRT than conventional SBRs. The anaerobic selector also creates soluble carbon as a food source for biological nutrient removal through anaerobic conversion of settleable BOD to soluble BOD.

The influent then flows to the SAM™ surge basin (influent equalization basin). The surge basin provides flow and nutrient equalization to optimize treatment at the full range of flows and loadings. When the level in the surge basin reaches a predetermined level, the jet motive liquid/fill pump is started, and a batch is quickly fed to the reactor basin.

Several unique feature of the Fluidyne ISAM™ SBR include odor control and scum skimming. Mixed liquor is maintained in the SAM™ tank to immediately react with incoming flow from the anaerobic chamber to suppress odors and initiate and accelerate carbon and nitrogen reactions. Mixed liquor from the SBR tank overflows the proprietary flow and scum control system weir, and is returned to the SAM™ surge basin, and mixed with incoming wastewater in what is referred to as an "Interact" period. In addition, nitrates are recycled to the SAM™ tank for effective and rapid denitrification. Denitrification reactions are accelerated in the presence of the unreacted soluble carbon from the raw sewage entering the SAM™ tank. Aeration and energy requirements are reduced as nitrates are fully reduced to nitrogen gas in the SAM™ tank.

## FLUIDYNE PREPACKAGED ISAM™ SBRS

The Fluidyne prepackaged ISAM™ SBR is available in standard sizes for average influent flows from 5,000 GPD to 110,000 GPD. Each unit is shipped complete; prewired and prepiped. Packaged systems can be buried or installed above grade on customer provided concrete pad.

## 100% ON-LINE STANDBY EQUIPMENT

Fluidyne's prepackaged ISAM™ SBRs are furnished with spare mixing/fill pump and aerator assembly installed for 100% redundancy.

## REDUCES WASTE SLUDGE BY 80%

The Fluidyne ISAM™ Sequencing Batch Reactor incorporates an anaerobic selector chamber with the SAM™ SBR. All influent flow enters the anaerobic chamber where influent solids settle. The anaerobic selector chamber also creates soluble carbon as a food source for denitrification through anaerobic conversion of settleable BOD to soluble BOD. During the "Interact" phase, a portion of the motive liquid is also recirculated to the anaerobic selector chamber where the mixed liquor solids are converted from an aerobic-dominant population to a facultative-dominant population. Aerobic bacteria are selectively destroyed while enabling the low-yield, facultative bacteria to breakdown and utilize the remains of the aerobes and their byproducts. The mixed liquor then flows to the SAM™ surge basin where the facultative bacteria, in turn, are out-competed by the aerobic bacteria and subsequently broken down in the alternating environments of the aerobic SBR treatment process and the anaerobic chamber. A balance between selection and destruction is developed between the anaerobic selector chamber and the SBR treatment process resulting in extremely low net biological solids produced. The ISAM™ process will reduce the volume of waste sludge by approximately 80%, compared to a conventional SBR/aerobic digester system, and eliminate the need for separate digesters.

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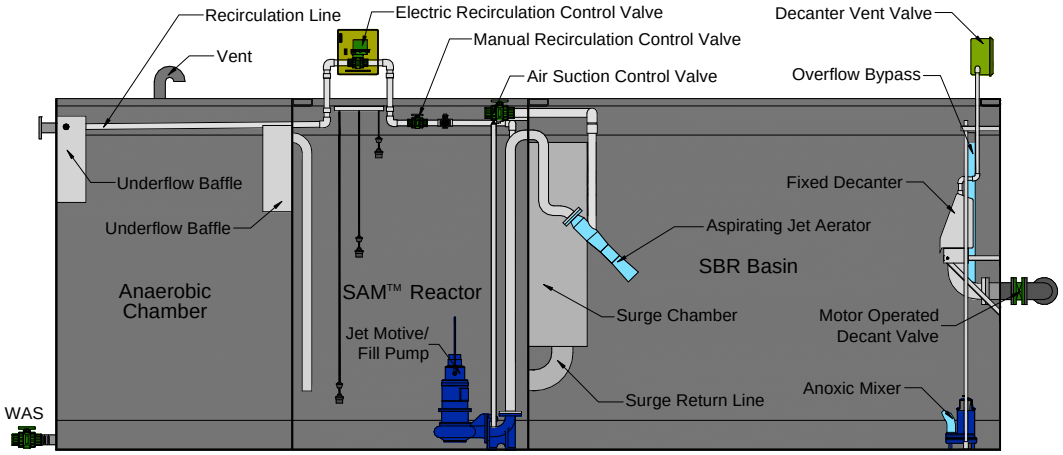
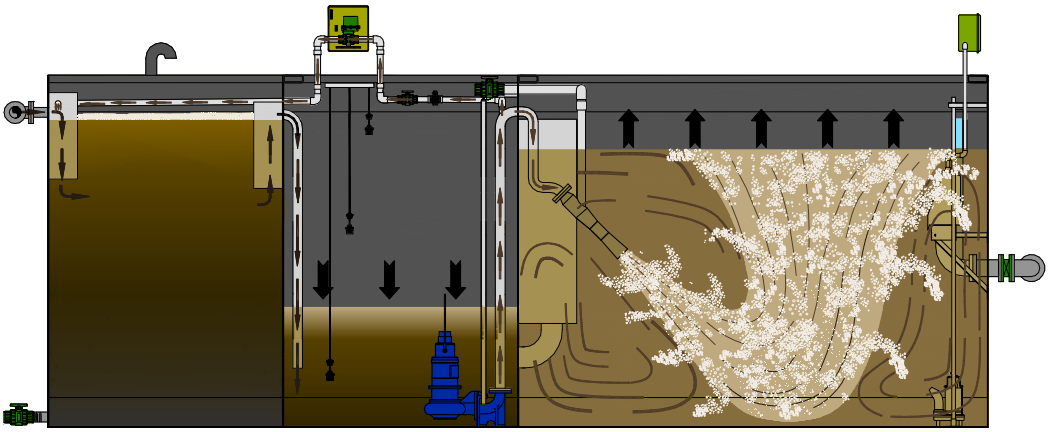
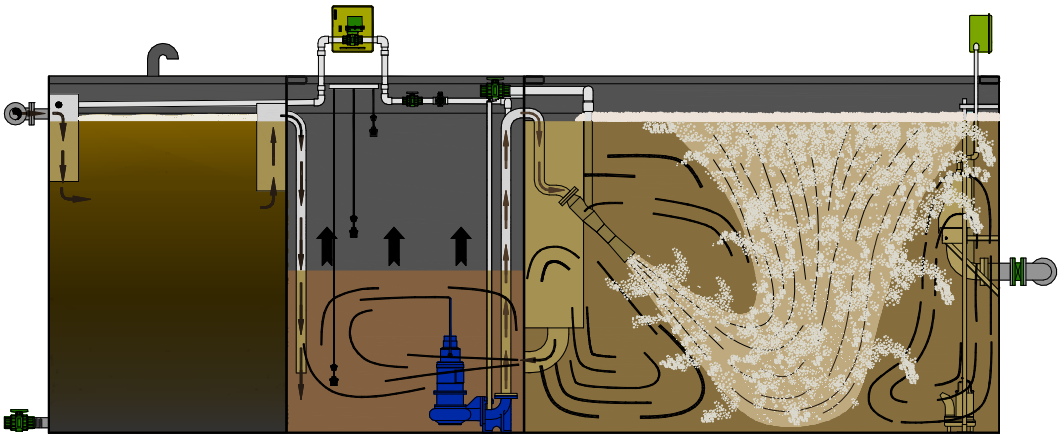



**System Components:** Influent continuously enters the anaerobic chamber where solids settle. Settleable BOD is converted to soluble BOD. BOD is reduced by 30%, and solids are reduced by 60%. The influent then flows to the SAM™ reactor. Mixed liquor is maintained in the SAM™ reactor to suppress odors, and initiate and accelerate carbon and nitrogen reduction.



**Fill Phase:** When the level in the SAM™ reactor reaches a predetermined “control level” the motive liquid pump is started. The SBR basin is filled and mixed. A percentage of the pumped flow is returned to the anaerobic chamber where biological solids settle. The recycle flow is adjustable to maintain the desired MLSS concentration in the SBR basin. Settled solids in the anaerobic chamber are digested.



**Interact Phase:** When the level in the SBR reaches TWL, nitrified mixed liquor overflows the surge chamber weir and is returned to the SAM™ chamber to mix and react with the raw influent. Aeration is cycled on and off to provide the required oxygen. Denitrification is reliable and complete. Scum is also removed from the SBR basin.

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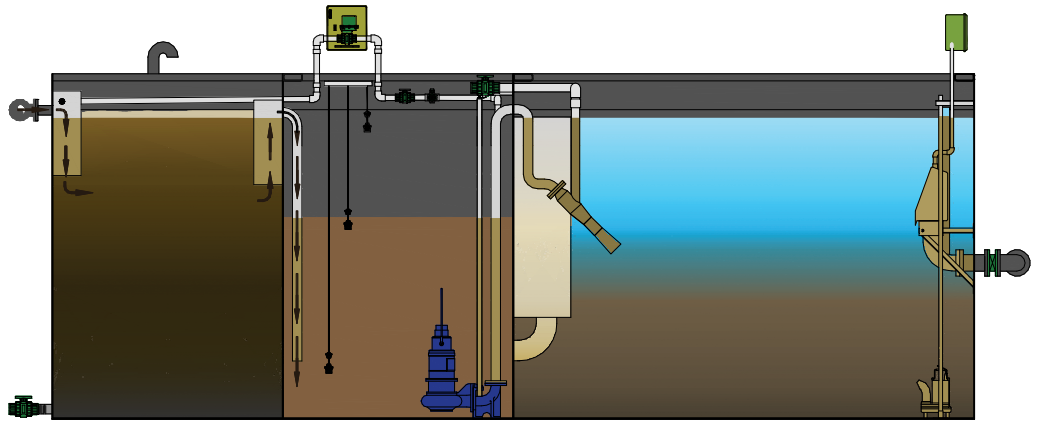
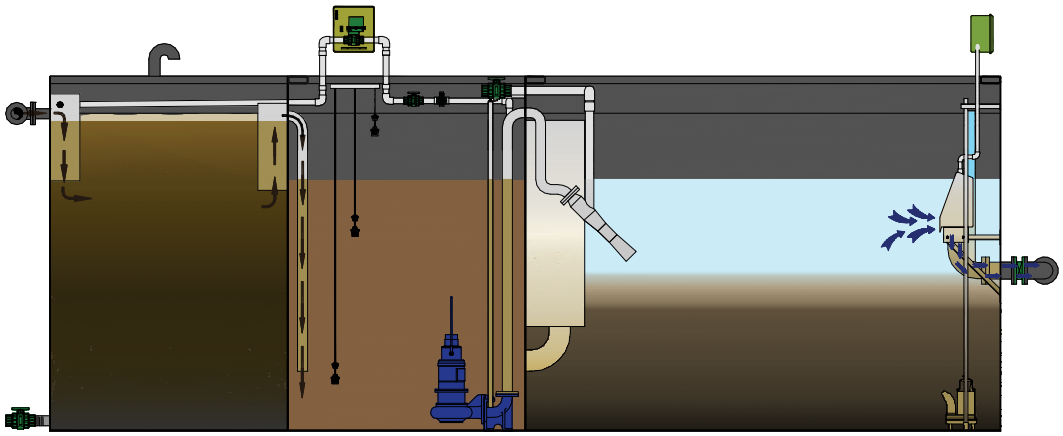
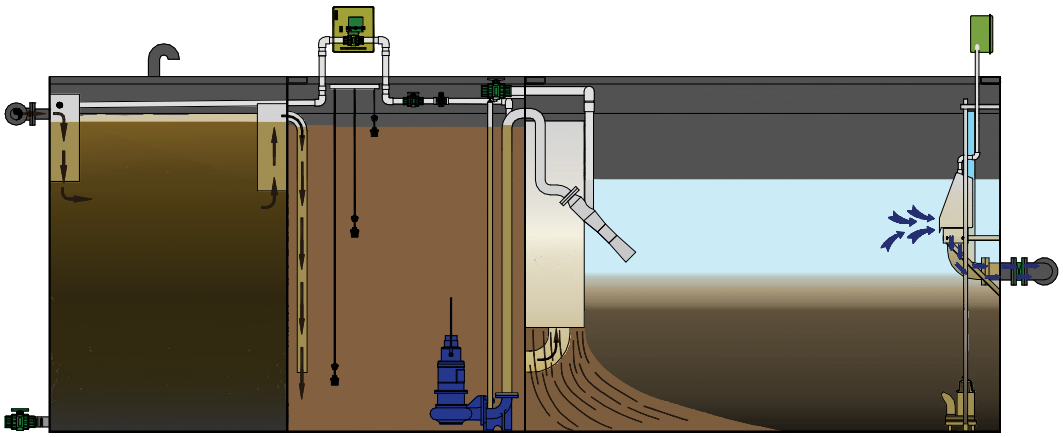


**Settle Phase:** When the level in the SAM™ reactor again reaches "control level," aeration is discontinued, and the SBR basin settles under perfect quiescent conditions.



**Decant Phase:** When the settle timer expires, the decant valve is opened, and treated effluent is withdrawn from the upper portion of the SBR basin by means of a fixed solids excluding decanter.



**Filled Decant Phase:** If, during peak flow events, the SAM™ reactor reaches TWL before the decant phase ends, influent flows in a reverse direction through the surge return line and overflows the surge chamber secondary weir, and is diffused into the settled sludge at very low velocity as the decant phase continues.

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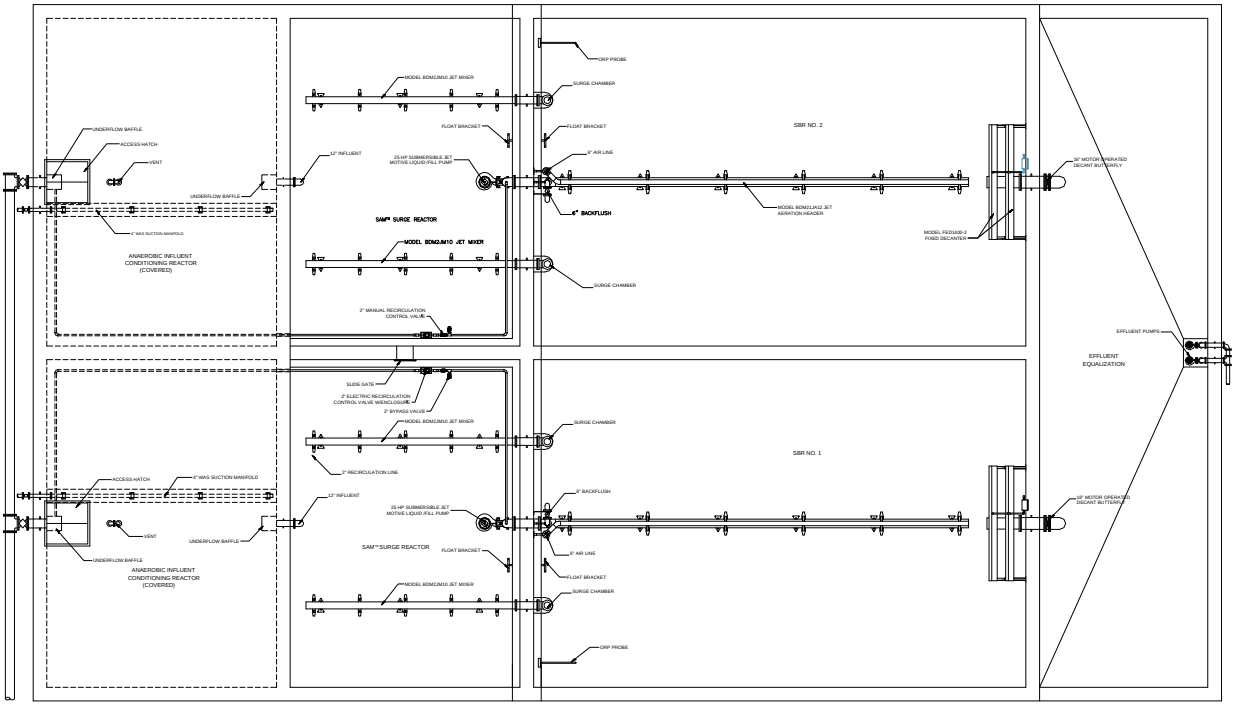
## CUSTOM ENGINEERED ISAM™ SYSTEMS

The majority of ISAM™ systems currently operating are packaged systems for daily flows of less than 100,000 GPD. However, the process offers the same advantages for larger facilities. The first advantage is that the ISAM™ requires smaller SBR basins than a conventional SBR, at identical loadings. This is due to the fact that 65% of the influent solids are removed in the anaerobic chamber, and are therefore not considered in calculation of the SRT. An ISAM™ designed for an average daily daily flow of 1.0 MGD, and an SRT of 20 days will have an SBR basin capacity of 0.67 MG, and an HRT of 16 hours. A conventional SBR designed for a 20 day SRT would have a capacity of 1.24 MG, and an HRT of 30 hours. The 1.0 MGD ISAM™ SBR design also includes the SAM™ reactor having a capacity of 0.14 MG. Since the SAM™ reactor contains mixed liquor, the actual working SRT for the ISAM™ process is 25 days, and the total volume is only 66% of that of the conventional SBR.

The ISAM™ design also includes two anaerobic influent conditioning chambers having a total capacity of 0.50 MG. Therefore, the total volume of the entire ISAM™ SBR process is 1.31 MG, and no additional digesters are required. Aerobic digesters for a conventional 1.0 MGD SBR would have a capacity of 0.30 MG if designed for a 30 day sludge age. This means that the total volume for a 1.0 MGD conventional SBR plus aerobic digesters would be 1.54 MG. The total volume for the ISAM™ process is 1.31 MG.

The total power consumption for a 1.0 MGD conventional SBR plus aerobic digestion would be approximately 1,680 KWH/day. The total power consumption for a 1.0 MGD ISAM™ SBR is approximately 845 KWH/day; 50% less than a conventional SBR.



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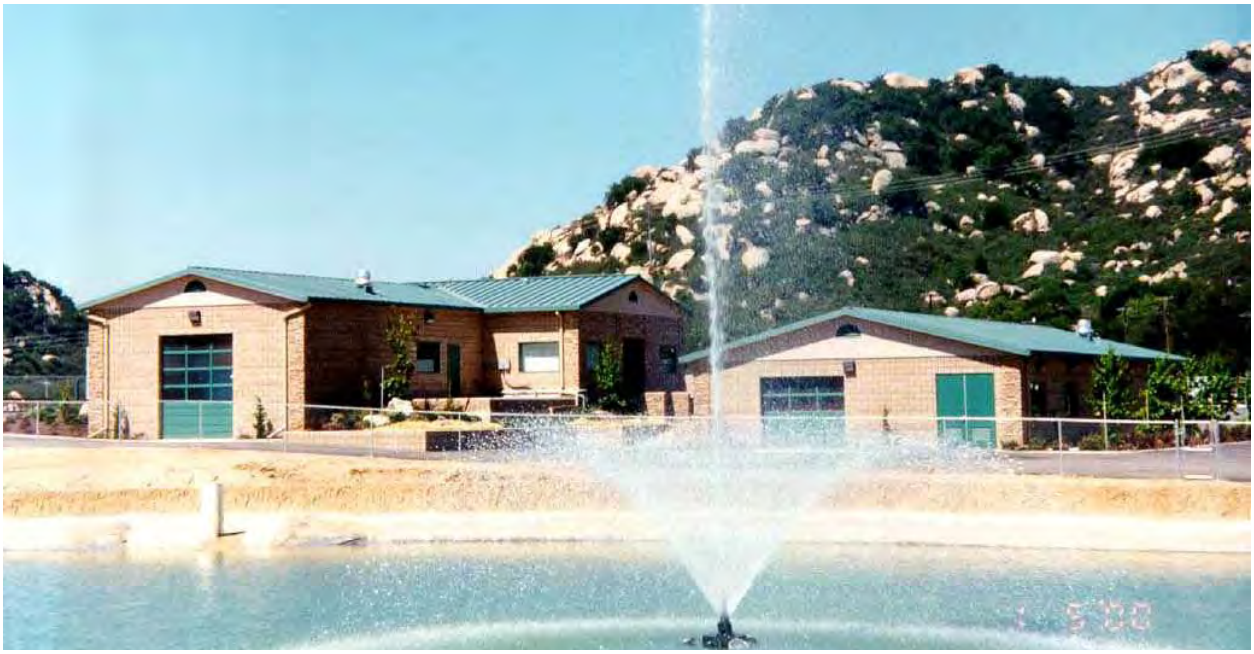

**FLUIDYNE SAM™ SBR - BARONA, CA - WEEKLY REPORTS**

| | INFLUENT | | | | | EFFLUENT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE** | **$BOD_5$** | **TSS** | **$NH_3$-N** | **TKN** | **FOG** | **$BOD_5$** | **TSS** | **$NH_3$-N** | **$NO_3$** | **$NO_2$** | **TKN** | **FOG** |
| 02/16/05 | 632 | 327 | 20.2 | 36.0 | 64.8 | 2.0 | ND | ND | 0.1 | 0.02 | 0.50 | <1.0 |
| 02/23/05 | 338 | 226 | 6.7 | 7.8 | 45.5 | ND | ND | ND | ND | 0.02 | 0.60 | ND |
| 03/02/05 | 813 | 390 | 23.5 | 35.0 | 75.8 | 4.6 | ND | 2.0 | 0.1 | 0.01 | 0.80 | ND |
| 03/09/05 | 653 | 328 | 15.1 | 22.7 | 88.8 | 4.9 | ND | 0.2 | 0.3 | ND | 1.10 | ND |
| 03/16/05 | 640 | 237 | 23.7 | 35.9 | 79.4 | 2.7 | ND | 0.2 | 0.3 | 0.02 | 1.10 | ND |
| 03/23/05 | 385 | 445 | 24.1 | 38.2 | 80.7 | 2.2 | ND | 2.0 | 0.2 | 0.13 | 0.70 | ND |
| 03/30/05 | 736 | 358 | 15.2 | 19.3 | 217.0 | 10.0 | ND | 0.1 | 0.1 | 0.03 | 0.50 | ND |
| 04/06/05 | 627 | 338 | 28.3 | 34.5 | 97.0 | 9.0 | ND | 0.4 | ND | ND | 0.40 | ND |
| 04/13/05 | 784 | 356 | 23.0 | 27.2 | 31.0 | 12.0 | ND | 0.5 | ND | ND | 0.70 | ND |
| 04/20/05 | 336 | 223 | 14.0 | 16.6 | 8.4 | 3.5 | 1.9 | 0.4 | ND | ND | 3.30 | <1 |
| 04/27/05 | 579 | 485 | 6.7 | 8.9 | 27.5 | <2 | ND | 0.3 | ND | ND | 3.10 | <1 |
| 05/04/05 | 940 | 334 | 1.0 | 33.1 | 48.9 | 2.9 | 2.5 | 1.0 | 0.1 | 0.08 | 2.60 | <1 |
| 05/11/05 | 622 | 330 | 22.2 | 74.2 | 66.7 | <2 | ND | ND | ND | ND | 1.80 | ND |
| 05/18/05 | 718 | 329 | 20.8 | 28.0 | 492.0 | 2.2 | ND | ND | ND | ND | 0.49 | ND |
| 05/25/05 | 575 | 322 | 13.1 | 13.3 | 450.0 | 4.6 | ND | 0.5 | ND | ND | 0.50 | ND |
| 06/01/05 | 711 | 688 | 24.0 | 25.8 | 327.0 | 12.3 | ND | 0.5 | 0.2 | ND | 0.50 | ND |
| 06/08/05 | 508 | 277 | 22.4 | 27.9 | 52.6 | 2.4 | NO | 0.1 | 0.4 | ND | 0.70 | <1 |
| 06/15/05 | 343 | 155 | 14.9 | 22.5 | 90.8 | <2 | ND | 0.5 | 0.4 | ND | 1.00 | ND |
| 06/22/05 | 661 | 477 | 27.6 | 33.5 | 87.2 | <2 | ND | 0.2 | 0.4 | ND | 0.70 | 1.1 |
| 06/29/05 | 444 | 345 | 32.6 | 50.5 | 61.5 | 2.0 | ND | 0.1 | 0.3 | 0.03 | 0.50 | ND |
| 07/06/05 | 925 | 379 | 27.6 | 48.1 | 87.5 | 1.7 | ND | 0.2 | 0.3 | 0.03 | 0.80 | ND |
| 07/13/05 | 673 | 346 | 33.1 | 52.5 | 99.5 | <2 | ND | 0.5 | 0.5 | ND | 0.90 | <1.0 |
| 07/20/05 | 650 | 109 | 29.1 | 43.0 | 84.9 | <2 | ND | 0.1 | ND | 0.04 | 0.70 | <1.0 |
| 07/27/05 | 694 | 305 | 33.0 | 43.0 | 83.1 | <2 | ND | 0.2 | 0.3 | 0.08 | 0.40 | ND |
| 08/03/05 | 580 | 324 | 26.3 | 28.0 | 65.9 | 3.6 | ND | 0.6 | 0.3 | 0.02 | 0.80 | ND |
| **AVG. YTD** | **623** | **337** | **20.9** | **32.2** | **116.5** | **4.6** | **ND** | **0.4** | **0.2** | **0.03** | **1.01** | **ND** |

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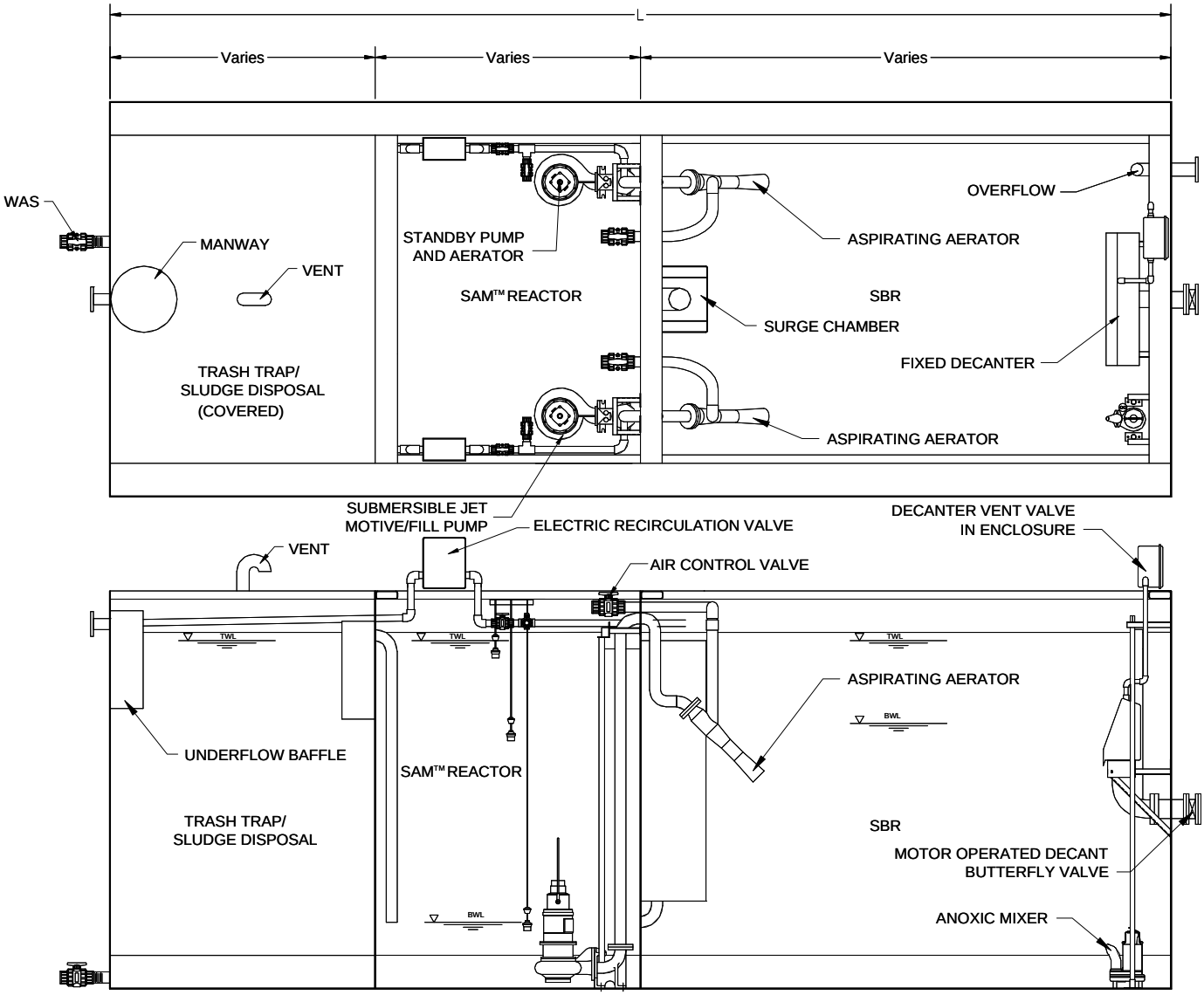


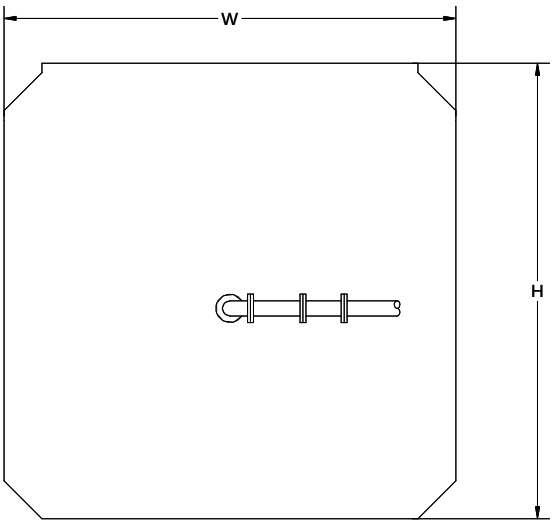


| MODEL | W | L | H | HP* |
|---|---|---|---|---|
| ISAM™05 | 6.5 | 16 | 10.0 | 3 |
| ISAM™10 | 8.5 | 24 | 10.0 | 5 |
| ISAM™15 | 8.5 | 24 | 12.0 | 5 |
| ISAM™20 | 11.9 | 24 | 12.0 | 7.5 |
| ISAM™25 | 11.9 | 30 | 12.0 | 7.5 |
| ISAM™30 | 11.9 | 34 | 12.0 | 10 |
| ISAM™40 | 11.9 | 45 | 12.0 | 10 |
| ISAM™42 | 11.9 | 48 | 12.0 | 10 |
| ISAM™50 | 11.9 | 56 | 12.0 | 15 |
| ISAM™60 | 11.9 | 68** | 12.0 | 20 |
| ISAM™70 | 11.9 | 72** | 12.0 | 20 |
| ISAM™75 | 11.9 | 80** | 12.0 | 25 |
| ISAM™80 | 11.9 | 90** | 12.0 | 25 |
| ISAM™90 | 11.9 | 96** | 12.0 | 30 |
| ISAM™100 | 11.9 | 112** | 12.0 | 40 |
| ISAM™110 | 14.0 | 112** | 12.0 | 40 |

* EACH PUMP (ONE IS STANDBY)
** TWO TANKS (EACH TANK IS HALF OF TOTAL LENGTH)

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## The Fluidyne ISAM™ SBR system provides the following benefits,

1. Ability to handle highly variable flows and loading associated with small, to medium size plants. The ISAM™ is more flexible than continuous flow plants. Regardless of flows or loading, aeration and mixing can automatically be adjusted to optimize power and prohibit filamentous growth.

2. At high flows, solids cannot wash out as with extended aeration plants as the ISAM™ SBR process utilizes quiescent settle and decant.

3. ISAM™ facilities are easily expandable by adding a new tank. The additional tank does not require major changes in controls; only a new tank and associated equipment.

4. ISAM™ provides a small footprint with no digesters, secondary clarifiers, RAS piping and pumping.

5. ISAM™ produces the highest quality effluent. Typical Fluidyne ISAM™ facilities are achieving less than 10 mg/l BOD and TSS, less than 1 mg/l $NH_3$-N, less than 5 mg/l total N, and less than 2 mg/l phosphorous.

6. Easy to operate and maintain as mechanical equipment is minimized with no chasing of sludge associated with extended aeration plants.

7. Use of self-aspirating jet aerators eliminate blowers and blower accessories.

8. Built in sludge reduction system using the anaerobic selector chamber significantly reduces sludge handling and hauling costs.

9. 100% stand-by aerator is included with the system to allow continuous operation with one unit out of service.

10. Built in flow equalization is provided in the ISAM™ reactor to handle peak hourly flows.

11. Automatic scum skimming prior to effluent discharge provides highest quality effluent.

12. Exceptional after sales service by Fluidyne technicians. Fluidyne employees have been granted over 40 patents in wastewater and water treatment technology and equipment.

13. Reduced operation and maintenance costs as power usage is controlled through the Fluidyne control panel.

14. Installed cost is lower as the system comes with the in-basin equipment pre-installed

15. The anaerobic selector chamber is covered and raw wastewater reacts immediately with mixed liquor in an aerated environment, there are no odor concerns.

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