A GUIDE TO OPTIMIZING IN-TANK AGITATION & MIXING USING EDUCTORS

Spraying Systems Co.
Experts in Spray Technology
Tank mixing eductors are widely used in many applications to effectively and efficiently mix tank solutions. Offering many benefits over other approaches such as pipes with holes, liquid agitators and pumps, tank mixing eductors feature different operating principles and are available in many styles, sizes and materials. To ensure optimal mixing performance, it is important to understand these product differences and how to specify and install eductors. Our local spray experts are standing by and ready to provide assistance.

**TANK MIXING EDUCTOR BENEFITS**

- **Ensures homogeneous fluid mix throughout the tank**
  - More thorough mixing results in solution uniformity – temperature, pH level, solids/gas dispersion and chemical distribution – to help ensure product/process quality
  - Eliminates sludge build-up and reduces tank cleaning time

- **Enables the use of small pumps to circulate large volumes of tank solution**
  - Smaller pumps are less costly to purchase
  - Smaller pumps are less costly to operate

- **Simplifies operation and maintenance – no moving parts**

- **Eliminates the need for compressed or blower air and the resulting oil contamination and/or ventilation problems**
## QUICK REFERENCE GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Inlet Flow Rate Range* gpm (lpm)</th>
<th>Circulation Rate Range* gpm (lpm)</th>
<th>Effective Flow Field Range** ft. (m)</th>
<th>Liquid Flow Rate/Air Flow Rate Range** gpm (lpm) and scfm (Nl/min)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>46550 Tank Mixing Eductor</strong></td>
<td>3.5 to 75 (11.3 to 308)</td>
<td>16.2 to 375 (53.3 to 1540)</td>
<td>3 to 46 (.91 to 14)</td>
<td>Not Applicable</td>
<td>6-7</td>
</tr>
<tr>
<td><strong>46550-ME Mini Tank Mixing Eductor</strong></td>
<td>.31 to 2.9 (1 to 11.7)</td>
<td>1.9 to 10.7 (6.2 to 43.6)</td>
<td>3 to 24 (7.6 to 61)</td>
<td>Not Applicable</td>
<td>8-9</td>
</tr>
<tr>
<td><strong>46550-AIE Air Induced Tank Mixing Eductor</strong></td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>0.82 to 3 (3 to 12.1) and 0.11 to 1.50 (3 to 48)</td>
<td>10-11</td>
</tr>
</tbody>
</table>

*10 to 50 psi (.5 to 4 bar).
**15 to 60 psi (1 to 5 bar).
***Effective Flow Field is defined as 1’ (30 cm) of flow/second.
1. START BY DETERMINING THE NEEDED TURNOVER RATE

How many times per hour does the tank solution need to circulate through the eductors? The answer is application-dependent and based on solution viscosity and the number of particulates. A general rule of thumb is 20 turnovers per hour. Here are some typical guidelines:

- Plating and rinsing tanks: 10 to 20 turnovers per hour although some plating tanks may require more than 30 turnovers per hour
- Cleaning tanks: at least 10 turnovers per hour
- Heavily soiled tanks: up to 20 turnovers per hour
- Critical cleaning tanks: more than 20 turnovers per hour

2. THEN CALCULATE THE NEEDED FLOW RATE

Multiply the appropriate turnover rate by the tank volume and then divide by 60

Example:

10 \times 800 \text{ (3028.3)} = 8,000 \text{ gph (30,283 l/hr)}

\[
\text{turnover rate } \frac{\text{tank volume}}{\text{per hour}} = \frac{8,000 \text{ gph}}{60} = 133.3 \text{ gpm (504.7 l/min)}
\]

3. DETERMINE THE NEEDED INLET FLOW RATE

Take the gallons (liters) per minute and divide by 5 since the eductors mix at a 5:1 ratio

Example:

133.3 \div 5 = 26.7 \text{ gpm (504.7 l/min)}
4. DETERMINE THE EDUCTOR SIZE NEEDED BY CONSULTING THE PERFORMANCE TABLE

Example: One 3/4” eductor will produce a flow rate of 27 gpm at 40 psi (106 l/min at 3 bar). If multiple eductors are to be used due to the configuration of the tank, take the needed inlet flow rate and divide by the flow rate of the eductors. In this case, using four, 1/4” eductors will provide a liquid flow rate of 28 gpm at 40 psi (121 l/min at 3 bar)

5. DETERMINE HOW MANY EDUCTORS YOU NEED

• You may need to use multiple eductors to obtain the needed flow rate
• You may want to use multiple eductors to prevent stagnation which is a common problem in square and rectangular tanks
• In general, using multiple eductors in larger tanks will provide more effective mixing than one centrally located eductor

6. DETERMINE EDUCTOR PLACEMENT

• Little agitation occurs below the level of the eductor, so eductors should be positioned as close as possible to the bottom of the tank for maximum liquid turnover
• If settling cannot be tolerated, install the eductors at 1’ (.3 m) above the bottom of the tank
• In general, eductors should be placed so the flow field will reach the farthest and highest liquid level at the opposite side of the tank
• Typical eductor configurations for various types of tanks and applications are shown above. Mounting adapters are available to direct flow as needed. Be sure to consult with your nozzle manufacturer to ensure optimal placement
• Typically, eductors are placed 12’ (.3 m) apart for even and uniform agitation

TANK MIXING EDUCTOR OPERATING PRINCIPLE

Pressurized liquid is pumped into the eductor. As the liquid exits at high velocity, it draws surrounding solution through the eductor’s flow-through chamber. This additional liquid flow mixes with the pumped solution and multiplies its volume.

Eductors can entrain up to five times the amount of pumped solution depending on the eductor size and design.

A+B: Circulation Rate
(A x 4 to 6 times)

B: Entrained Liquid
(A x 3 to 5 times)

A: Inlet Flow Rate

Diffuser
Flow-through Chamber
Nozzle
MODEL 46550 TANK MIXING EDUCTORS

LARGE FLOW PASSAGES
MINIMIZE CLOGGING
& MAXIMIZE LIQUID
CIRCULATION

FEATURES AND BENEFITS

• Entrains four times more solution than pumped solution
• Large flow opening allows particulates to pass through with minimal clogging
• Flow chamber design eliminates internal material build-up
• Compact design minimizes interference with plating racks and other in-tank equipment
• Wide range of material options
• In-tank mounting design eliminates the need for above tank mounting devices
• Mounting accessories simplify installation and allow easy, precise adjustment of eductor flow (See page 12 for mounting accessories ordering information)
• Ideal for use in anodizing, cleaning, electroplating, mixing, paint booth, phosphating, plating, rinsing and stripping applications

SPECIFICATIONS:

Materials: Kynar®, polypropylene**, cast 316 stainless steel
Inlet Conn. (in.): 1/4, 3/8, 3/4 and 1-1/2 NPT or BSPT (M)
Effective Flow Field: 3' to 46' (.91 to 14 m)
Dimensions: 3” to 10” length (76 to 254 mm); 1-1/4” to 4-1/2” (32 to 114 mm) outside diameter

*Maximum operating temperature with water is 220°F (104°C) at 50 psi (3.5 bar).
**Maximum operating temperature with water is 200°F (93°C) at 50 psi (3.5 bar).
### PERFORMANCE DATA: 46550 EDUCTORS

<table>
<thead>
<tr>
<th>Inlet Conn. (in.)</th>
<th>Flow Rate gpm (lpm)</th>
<th>Flow Rate Capacity gpm (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 psi (5.5 bar)</td>
<td>15 psi (8.3 bar)</td>
</tr>
<tr>
<td></td>
<td>20 psi (9.5 bar)</td>
<td>25 psi (12 bar)</td>
</tr>
<tr>
<td></td>
<td>30 psi (15 bar)</td>
<td>35 psi (18.5 bar)</td>
</tr>
<tr>
<td></td>
<td>40 psi (19 bar)</td>
<td>50 psi (23 bar)</td>
</tr>
</tbody>
</table>

#### 1/4
- **Inlet Flow Rate**: 3.5 (11.3), 4.3 (16.0), 5.0 (19.5), 5.5 (23), 6.1 (25), 6.6 (28), 7.0 (30), 7.8 (32)
- **Circulation Rate**: 16.2 (53.3), 19.4 (75), 22.8 (91.5), 25.1 (107), 28.1 (118), 30.6 (130), 33 (140), 36.8 (150)
- **Effective Flow Field (ft. m)**: 3.0 (.91), 5.0 (1.5), 7.0 (2.1), 8.5 (3.0), 10.0 (3.7), 12.0 (4.3), 14.0 (5.2)

#### 3/8
- **Inlet Flow Rate**: 9.0 (29), 11.0 (42), 12.5 (51), 14.0 (59), 16.0 (65), 17.0 (70), 18.0 (77), 19 (82)
- **Circulation Rate**: 45 (145), 55 (190), 62.5 (255), 70 (295), 80 (325), 85 (350), 90 (395), 100 (410)
- **Effective Flow Field (ft. m)**: 4.0 (1.2), 6.0 (1.8), 8.0 (2.4), 10.0 (3.0), 12.0 (3.7), 14.0 (4.3), 16.0 (5.2)

#### 3/4
- **Inlet Flow Rate**: 13.5 (43), 17.0 (56), 19.0 (74), 21 (85), 23 (97), 25 (106), 27 (116), 30 (124)
- **Circulation Rate**: 67.5 (215), 85 (280), 95 (370), 105 (425), 115 (485), 125 (530), 135 (580), 150 (620)
- **Effective Flow Field (ft. m)**: 5.0 (1.5), 6.0 (2.4), 8.0 (3.2), 10.0 (3.4), 12.0 (3.9), 14.0 (4.3), 16.0 (5.2)

#### 1-1/2
- **Inlet Flow Rate**: 33 (106), 40 (151), 47 (184), 53 (215), 58 (243), 63 (259), 66 (288), 75 (308)
- **Circulation Rate**: 165 (530), 200 (700), 235 (920), 265 (1075), 290 (1215), 315 (1295), 330 (1440), 375 (1540)
- **Effective Flow Field (ft. m)**: 7.5 (2.3), 12.0 (4.9), 16.0 (6.1), 20 (7.3), 24 (8.8), 29 (10.4), 34 (12.4), 46 (14.3)

*Effective Flow Field is defined as 1’ (30 cm) of flow/second.*

### DIMENSIONS AND WEIGHTS

<table>
<thead>
<tr>
<th>Inlet Conn. (in.)</th>
<th>Orifice Dia. in. (mm)</th>
<th>L in. (mm)</th>
<th>Dia. in. (mm)</th>
<th>Weight oz. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>3/16 (5)</td>
<td>3 (76)</td>
<td>1-1/4 (32)</td>
<td>KY</td>
</tr>
<tr>
<td></td>
<td>5/16 (8)</td>
<td>4-1/16 (103)</td>
<td>1-1/16 (52)</td>
<td>PP</td>
</tr>
<tr>
<td></td>
<td>3/8 (10)</td>
<td>6-3/8 (162)</td>
<td>3 (76)</td>
<td>KY</td>
</tr>
<tr>
<td></td>
<td>9/16 (14)</td>
<td>10 (254)</td>
<td>4-1/2 (114)</td>
<td>PP</td>
</tr>
</tbody>
</table>

**Ordering Information**

**MODEL 46550 TANK MIXING EDUCTORS**

- **Model No.**
- **Inlet Conn.**
- **Material Code**

**Example**

```
46550 - 3/8 - PP
```

BSPT connections require the addition of a "B". Example B46550 – 3/8 – PP.
COMPACT DESIGN MAXIMIZES LIQUID CIRCULATION & AGITATION

FEATURES AND BENEFITS

• For use in applications with lower flow rates
• Entrain three to five times more solution than pumped solution as it passes through the eductor/diffuser
• Circulation is six times greater than using pipe holes or agitation with air
• Flow-through chamber minimizes clogging
• Compact design simplifies mounting and is ideal for small tanks
• Ideal for use in paint booth pre-treatment, etching and plating tanks
• Color-coded by flow size for quick identification (polypropylene only)

SPECIFICATIONS:

Materials: Polypropylene®, PVDF and other similar materials optional

Inlet Conn. (in.): 1/4 NPT or BSPT (M)

Effective Flow Field: 3” to 24” (7.6 to 61 cm)

Dimensions: 1-5/8” x 11/16” (length x outside dia.) (40 x 17 mm)

*Maximum operating temperature with water is 200°F (93°C) at 50 psi (3.5 bar).

HOW THE MINI TANK MIXING EDUCTOR WORKS:

Pressurized liquid is pumped through the eductor. As liquid exits the diffuser at high velocity, surrounding solution is entrained in the open flow-through chamber. The combination of pumped flow and pulled flow significantly increases circulation.

Mini Eductors are available in four capacities with inlet flow rates up to 2.9 gpm (11.7 l/min).
### PERFORMANCE DATA: 46550 EDUCTORS

<table>
<thead>
<tr>
<th>Inlet Conn</th>
<th>Capacity</th>
<th>Color Code*</th>
<th>Flow Rate gpm (lpm)</th>
<th>Flow Rate Capacity gpm (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 psi (5.5 bar)</td>
<td>15 psi (1.1 bar)</td>
</tr>
<tr>
<td>1/4</td>
<td>1.5</td>
<td>Orange</td>
<td>.31 (1.0)</td>
<td>.38 (1.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet Flow Rate</td>
<td>Circulation Rate</td>
</tr>
<tr>
<td>1/4</td>
<td>2.0</td>
<td>Green</td>
<td>.56 (1.8)</td>
<td>.69 (2.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet Flow Rate</td>
<td>Circulation Rate</td>
</tr>
<tr>
<td>1/4</td>
<td>2.5</td>
<td>Blue</td>
<td>.86 (2.7)</td>
<td>1.1 (4.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet Flow Rate</td>
<td>Circulation Rate</td>
</tr>
<tr>
<td>1/4</td>
<td>3.0</td>
<td>White</td>
<td>1.3 (4.2)</td>
<td>1.6 (5.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet Flow Rate</td>
<td>Circulation Rate</td>
</tr>
</tbody>
</table>

* Color coding available for polypropylene material only.

**Effective Flow Field is defined as 1' (30 cm) of flow/second.

### DIMENSIONS AND WEIGHTS

<table>
<thead>
<tr>
<th>Inlet Conn. (in.)</th>
<th>Orifice Dia. (in. mm)</th>
<th>L (in. mm)</th>
<th>Dia. (in. mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>.059 (1.5)</td>
<td>1-5/8 (40)</td>
<td>11/16 (17)</td>
</tr>
<tr>
<td>1/4</td>
<td>.079 (2.0)</td>
<td>1-5/8 (40)</td>
<td>11/16 (17)</td>
</tr>
<tr>
<td>1/4</td>
<td>.098 (2.5)</td>
<td>1-5/8 (40)</td>
<td>11/16 (17)</td>
</tr>
<tr>
<td>1/4</td>
<td>.118 (3.0)</td>
<td>1-5/8 (40)</td>
<td>11/16 (17)</td>
</tr>
</tbody>
</table>

### ORDERING INFORMATION

MINI TANK MIXING EDUCTOR

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Inlet Conn.</th>
<th>Mini-Eductor Designation</th>
<th>Nozzle Size</th>
<th>Material Code</th>
</tr>
</thead>
</table>

Example: 46550 – 1/4 ME – 1.5 – PP

Other materials available upon request. BSPT connections require the addition of a “B”. Example: B46550 – 1/4 ME – 1.5 – PP.
AIR INDUCED TANK MIXING EDUCTORS

POWERFUL BUBBLING ACTION IMPROVES CLEANING EFFICIENCY WITHOUT COMPRESSED AIR

FEATURES AND BENEFITS

• Circulated liquid flow is combined with induced air to generate small air bubbles that improve operational efficiency
  – Air bubbles provide an added scrubbing action when used for plating, dip cleaning or parts cleaning
  – Air bubbles elevate tank particulate and encapsulate debris for easier filtration of tank solution when used for mixing and agitation
• Unique injector design creates a wide 30° to 50° angle for added coverage and capture of particulates
• Easily change flow rates using interchangeable orifice plates (stainless steel models only)
• Ideal for use in dip cleaning, metal particulate carry off and liquid agitation

SPECIFICATIONS:

| Liquid Flow Rate Range: 0.82 to 3 gpm (3 to 12.1 l/min) |
| Materials: PVC and stainless steel |
| Installation Types: |
| Standard hook-up or wall-mount |
| PVC models are for wall-mount installation only |
| Liquid Inlet Conn. (in.): |
| 3/8 BSPT (F) for stainless steel models |
| 1/2 BSPT (F) for PVC models |
| Air Inlet Conn. (in.): 1/4 BSPT (F) – All models |

HOW THE AIR INDUCED EDUCTOR WORKS

Liquid flow from two orifices combines with air drawn from outside the tank to produce a powerful flow.
PERFORMANCE DATA: 46550 EDUCTORS

<table>
<thead>
<tr>
<th>Inlet Conn. (in.)</th>
<th>Capacity Size</th>
<th>Flow Rate gpm (lpm)</th>
<th>Flow Rate Capacity gpm (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquid Flow Rate</td>
<td>15 psi (1 bar)</td>
</tr>
<tr>
<td>3/8&quot; 1/2&quot;</td>
<td>5</td>
<td>.82 (3.0)</td>
<td>.92 (4.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Induced Air Flow Rate</td>
<td>scfm (Nl/min)</td>
</tr>
<tr>
<td>3/8&quot; 1/2&quot;</td>
<td>7</td>
<td>1.10 (4.1)</td>
<td>1.30 (5.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Induced Air Flow Rate</td>
<td>scfm (Nl/min)</td>
</tr>
<tr>
<td>3/8&quot; 1/2&quot;</td>
<td>10</td>
<td>1.70 (6.3)</td>
<td>1.90 (8.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Induced Air Flow Rate</td>
<td>scfm (Nl/min)</td>
</tr>
</tbody>
</table>

The flow rate table is based on the following specifications: Depth of eductor from water surface: 8" (220 mm). Induced Air Side: 5/16" (8 mm) I.D. tubing. Max. Length = 20" (500 mm).
*Stainless steel (SS) – in-tank or wall mount.
** Polyvinyl chloride (PVC) – wall mount.

DIMENSIONS AND WEIGHTS

ORDERING INFORMATION

AIR INDUCED TANK MIXING EDUCTORS

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Inlet Conn.</th>
<th>Eductor Type</th>
<th>Installation Type</th>
<th>Capacity</th>
<th>Material Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>B46550</td>
<td>3/8</td>
<td>AIE</td>
<td>T</td>
<td>10</td>
<td>SS</td>
</tr>
</tbody>
</table>

## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Inlet Conn. (in.)</th>
<th>Pipe size (in.)</th>
<th>Materials</th>
<th>CP20582 Threaded Ball</th>
<th>Eductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>37235 Adjustable Ball-Type Assembly</td>
<td>1/4, 3/8, 1/2</td>
<td>NA</td>
<td>Polypropylene (PP)</td>
<td>Required Accepts 1/4&quot; and 3/8&quot; (M)</td>
<td>Model 46550® 1/4&quot; and 3/8&quot; sizes only</td>
</tr>
<tr>
<td>38625 Hinged Split-Eyelet</td>
<td>NA</td>
<td>1-1/4, 1-1/2</td>
<td>Polypropylene (PP)</td>
<td>Required Accepts 1/4&quot; and 3/8&quot; (M)</td>
<td>Model 46550® 1/4&quot; and 3/8&quot; sizes only</td>
</tr>
</tbody>
</table>

*See pages 6 and 7 for eductor ordering information.
See data sheets 37235-2 and 38625 for more information.

## ORDERING INFORMATION

### 37235 ADJUSTABLE BALL-TYPE ASSEMBLY

<table>
<thead>
<tr>
<th>Assembly No.</th>
<th>Threaded Ball</th>
<th>Inlet Conn.</th>
<th>Material Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>37235 + CP20582 + 1/4 - PPB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 38625 HINGED SPLIT-EYELET

<table>
<thead>
<tr>
<th>Assembly No.</th>
<th>Threaded Ball</th>
<th>Pipe Size</th>
<th>Material Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>38625 + CP20582 + 1-1/4 - PPB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Spraying Systems Co.*
Experts in Spray Technology

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