

TANK MIXING**JGS 210-120-1-66E**

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1. SCOPE

This standard practice provides the guidelines for basic designs of tank mixing devices mainly for oil refinery or petrochemical plants. However, most descriptions within this practice are applicable to many other plants, for example, for producing food etc.

Basically there are two methods to perform mixing in a large tank. One is to use side-entering agitator(s) and the other is to use jet nozzle(s).

Moreover, two types of jet nozzle are used. One is a simple jet nozzle which has a single nozzle and usually installed on a tank side wall. On the other hand, a rotary jet nozzle consists of multiple nozzles (usually two nozzles) and is located inside a tank (usually at the center of a tank). Typical jet nozzles (side-entering jet nozzles) are shown in **Figs. 1, 2**.

It should be noted that only side-entering jet mixer is treated in this manual.

2. WORK PROCEDURE

2.1 Input to the Design

Summarized input data to be prepared prior to a basic design work of mixer design are listed below.

- (1) Liquid Properties
 - Density, Viscosity, (miscibility)
- (2) Tank Conditions
 - Tank Diameter
 - Liquid Height at Mixing Operation
- (3) Process Condition
 - Pump Capacity(Performance Curve of a pump)
 - Mixing Time(if required)

2.2 Design Outputs

The design outputs for jet nozzle are as follows.

- Nozzle Inclination Angle
- Nozzle Diameter

2.3 Work Steps

The calculation procedure is different depending on whether the pump is available or not.

2.3.1 Procedure-A

For the case when *the mixing pump is existing*.

- (1) Procedure of input data which is specified in 2.1 above.(Mixing time is not required.)
- (2) Decide nozzle inclination angle.
- (3) Calculate excess head.
- (4) Calculate head required and check the pump data.
If the pump head and capacity is not satisfied the requirement, new pump shall be provided.
The calculation procedure shall be changed to **Procedure-B**.
- (5) Calculate nozzle inner diameter.
- (6) Calculate mixing time.

2.3.2 Procedure-B

For the case when *any pump is not available*. In this case, pump shall be designed with the design of jet nozzle.

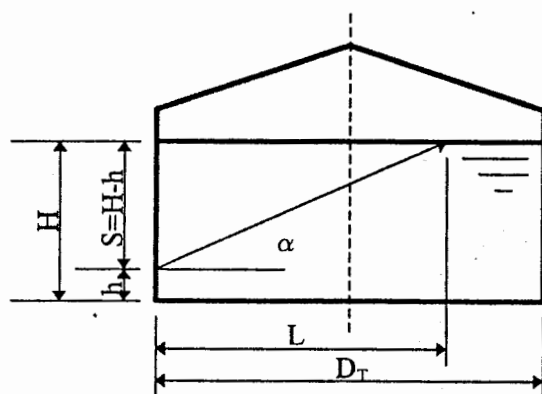
- (1) Procedure of input data which is specified in 2.1 above.
- (2) Decide nozzle inclination angle.
- (3) Calculate excess head.
- (4) Calculate head required for mixing.
- (5) Calculate nozzle flow rate based on the required mixing time.
- (6) Calculate nozzle inner diameter.

2.4 Computer Programs

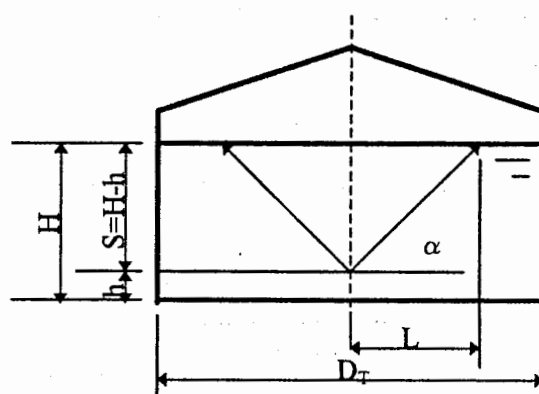
BEST will be available for rigorous sizing,

3. DESIGN**3.1 Design of Side-Entering Jet Nozzles**

Important factors in design of a jet mixer are nozzle inner diameter, nozzle inclination, nozzle jet velocity(jet flow rate), and mixing time.



Single Nozzle



Twin Nozzle

3.1.1 PROCEDURE-A

- (1) Select Type of Nozzle

Single Nozzle : Capacity < 15,000 kL

Twin Nozzle : Capacity ≥ 15,000 kL

- (2) Decide Nozzle Inclination, α .

$$\alpha = \tan^{-1} \left(\frac{S}{L} \right)$$

(1)

where

$$S = H - h \text{ (m)}$$

$$L = (2/3)D_T \text{ (for Single Nozzle) (m)}$$

$$L = (1/3)D_T \text{ (for Twin Nozzle) (m)}$$

H : liquid height(m)

h : nozzle elevation from tank bottom(m)

D_T : tank diameter(m)