

Eductor Pipe Size Selection For Purging Application

Key Features

Technology:

MS Office Excel

Duration:

The project was completed in a period of 1 week

Deliverables:

1. MS Excel based calculation

The Client

A leader in direct-fired, process heater applications since 1972, having the experience and expertise to handle any size project, anywhere in the world from complete new system design to replacement parts and field service, to instrumentation and controls. The client is committed to providing quality heat transfer equipment at a competitive price. Designs are optimized to save fuel, optimized to meet or exceed customer specifications, and optimized to accommodate individual project requirements.

The Business Need

The client wants to use a steam eductor/ejector in the heater stack to reduce the amount of time required to purge their heater. The client also requires four radiant volume changes to begin the pilot ignition sequence.

The client also wants to use a 1-1/2" diameter pipe with an extended radius elbow located at the center of the stack & is planning to use steam at a pressure of 145 psig and a temperature of 400°F as the motive force in the eductor.

Rishabh Engineering's scope is to provide a Calculation to show the required orifice size in the 1-1/2" elbow and the purge time needed for 4 volume changes. The client would also like to limit the purge time to 5 minutes if possible. The design condition is as follows:

Heater Design Conditions

- Firebox Volume – 15,000 ft³
- Stack Diameter (inside refractory) – 6'-2"
- Stack Cross-Sectional Area – 29.9 ft²

Eductor Design Conditions

- Media Type: Steam
 - Media Temperature: 400°F
 - Media Pressure: 145 psig
 - Eductor Pipe: 1.5 inches
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- Site Elevation – 1290 ft
 - Ambient Temperature – 60°F
 - Ambient Pressure – 14.03 psia
 - Ambient Density – 0.073 lb/ft³
 - Required Volume Changes in 5 minutes = 4
 - Specific heat ratio for purge media – 1.33

Rishabh's Solution

Rishabh Engineering performed the required calculations and submitted to the client after analyzing & calculating the design conditions.

We also suggested to check the calculation with below mentioned two Cases:

- **CASE I:** To provide the pipe sizing based on 3 volume changes. With that being the API requirement it might be acceptable to use that value rather than the earlier preferred 4 volume changes.
- **CASE II:** To provide the pipe sizing based on 4 volume changes in a 10 minute period. If this significantly reduces the pipe sizing and steam flow rates required.

Afterwards, Rishabh Engineering had re-analyzed & re-calculated both the above cases and submitted the final revised calculations to the client. Based on the estimates provided; Rishabh Engineering had suggested going ahead with CASE-II, and it is acceptable.

Principle Used

The ejectors are used to maintain a system vacuum in the upstream (Example supporting the vacuum column pressure) whereas eductor's primary objective is to take out the volume of any fluid out of the system by keeping a system pressure in the upstream.

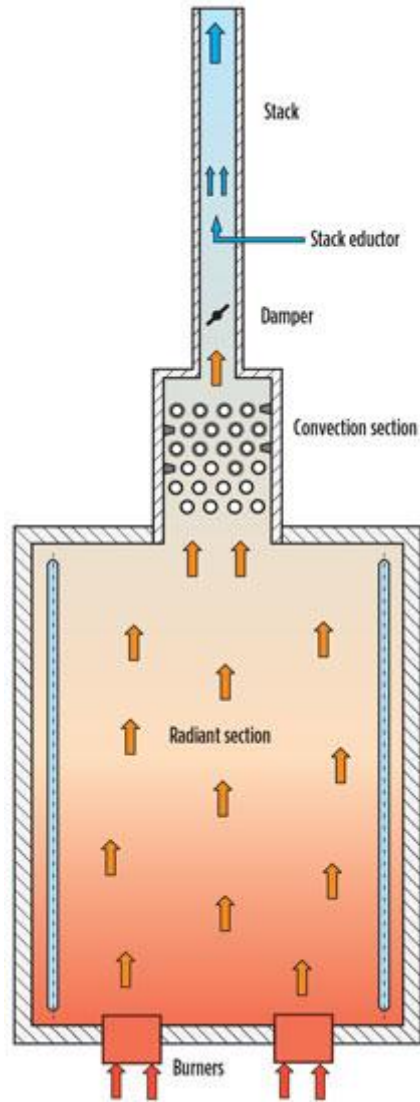
The eductors are used to remove the air four times the volume of the vessel per hour for the vessel entry jobs. One uses the compressed air OR steam as a motive fluid.

Hence the eductors can be used to transfer a considerable volume of fluid from low pressure to high pressure with high compression ratio than ejectors. Whereas the ejectors just suck the excess capacity of the system and maintain the system pressure accurately.

The difference is concerning their function and not relating to their motive fluid. The diameter of the ejector's throat is lesser than the eductor.

References Used

- Heat Exchange Institute Standard for Steam Jet Vacuum Systems
- Vendor Catalogues.



Eductor Pipe Size Selection for Purging Application

Technology Used

- Microsoft Office Excel

Key Deliverables

- Calculations for Pipe Size Selection

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About Rishabh Engineering

Rishabh Engineering provides multidisciplinary engineering support services to EPC companies in industries like Oil and Gas, Petrochemical, Power and Water treatment. Our parent company, Rishabh Software is a CMMI level-3, ISO9001 and ISO27001 company that provides services in Software Development, Business Process Outsourcing (BPO) and Engineering Services Outsourcing (ESO) to clients globally. Rishabh has offices in USA, UK and India with their main delivery center in Vadodara, India.