Where:

qf = flushing flow, in m^3/h

d = inside diameter of drainage pipe, in mm

MDP = maximum design pressure, in bar

K = Sum of individual K-factors for the components of the drainage pipework, dimensionless

7.5.4. Maximum Draining Flow

The maximum draining flow (qdr), which must be used to size air valves for pipeline draining, can be calculated by the following formula:

$$q_{dr} = 0.012524 \; x \; d^2 \sqrt{\frac{h_1 - h_2 - 10.195 \; x \; \Delta P}{K}}$$

Where:

qdr : maximum draining flow, in m^3/h

d = inside diameter of drainage pipe, in mm

h_1 = head of water above drain pipe at start of discharge, in m

h_2 = head of water above drain pipe at end of discharge, in m

ΔP = differential pressure, in bar

K = Sum of individual K-factors for the components of the drainage pipework, dimensionless

7.5.5. Draining Time

Sufficient washouts must be provided to limit the draining time of the section affected to a maximum of 4 h (14,400 s). The draining time can be obtained applying the Torricelli's formula as follows=

$$t = \frac{2 \; x \; A \; x \; \sqrt{K}}{a \; x \; \sqrt{2g}} \; x \; \left(\sqrt{h_1 - 10.195 \; x \; \Delta P} - \sqrt{h_2} \right)$$

Where:

t = draining time, in s

A = Surface area of the water in the pipeline, in m^2

K = Sum of individual K-factors for the components of the pipework, dimensionless

a = Cross sectional area of the drainage pipework, in m^2

g = gravity constant = 9.81 m/s^2

h_1 = head of water above drain pipe at start of discharge, in m

h_2 = head of water above drain pipe at end of discharge, in m

ΔP = differential pressure, in bar

The water surface takes the form of an ellipse during draining, which minor axis is equal to pipe diameter. The pipe slope affects the major axis. The surface area (A) is computed as

$$A = \pi \frac{D^2}{4 \; x \sin \delta}$$