ISI TRANSFERİ 1 DERSİ DÖNEM İÇİ ÖDEVİ

Yanma sonrası gazlar, bir tesisteki bacadan atmosfere 250 °C sıcaklıkta ve 25000 m^3/h debide atılmaktadır. Bu atık gazın ısısından ısıtmada yararlanılmak istenmektedir. Tesise 3 km mesafede bulunan her birinin ısıtma ihtiyacı yaklaşık 8 kW olan 40 konutluk bir site bulunmaktadır.

1- Sitedeki her evin sıcak su ihtiyacını da dikkate alarak kullanılacak ısı istasyonu kapasitesini belirleyin.

2- Isı istasyonu giriş/çıkış sıcaklığını ve eşanjör su giriş/çıkış sıcaklıklarını belirleyiniz. Eşanjörden çıkan suyun sıcaklığının 95°C' yi geçmemesi gerekmektedir. Tesis ile site arasındaki boru hattı yeraltı boru hattıdır. Tesisin bulunduğu bölgeyi göz önünde bulundurarak gerekli verileri belirleyin, hattaki ısı kayıplarını hesaplayın ve gerekli yalıtım kalınlığını bulunuz.

3- Kayıplar da dahil toplam kapasiteyi hesaplayın ve gerekli eşanjör boyutlarını belirleyiniz.

ÖDEVLER EN GEÇ 7 OCAK 2022 CUMA GÜNÜNE KADAR TESLİM EDİLMİŞ OLACAKTIR!!!

Homework

Gases after combustion are discharged from a flue in a facility to the atmosphere at a temperature of 250 °C and a flow rate of 25000 m^3/h. It is desired to benefit from the heat of this waste gas in heating. There is a site with 40 residences, each with a heating load of approximately 8 kW, located 3 km from the facility.

1- Determine the substation capacity to be used, taking into account the hot water requirement for each house on the site.

2- Determine the substation inlet/outlet temperature and the heat exchanger water inlet/outlet temperatures. The temperature of the water leaving the heat exchanger is required not to exceed 95 ° C. The pipeline between the facility and the site is underground pipeline. Determine the required data by considering the region where the facility is located, calculate the heat losses in the line and find the required insulation thickness.

3- Calculate the total capacity including losses and determine the required exchanger dimensions.

Kaynaklar/References:

https://www.tesisat.org/isi-istasyonu-sub-station-nedir.html

http://www1.mmo.org.tr/resimler/dosya_ekler/a954d0871e39892_ek.pdf

https://www.tesisat.org/isi-istasyonu-hesabi-ve-mekanik-proje-adimlari.html

8 Underground pipelines

8.1 General

Pipelines are laid in the ground with or without thermal insulation, either in channels or directly in the soil.

8.2 Calculation of heat loss (single line) without channels

8.2.1 Uninsulated pipe

The heat flow rate per metre, $q_{l,E}$, for a single underground pipe is calculated by Equation (73):

$$q_{l,E} = \frac{\theta_i - \theta_{sE}}{R'_l + R_E} \quad (73)$$

where

θ_i is the medium temperature;

θ_{sE} is the surface temperature of the soil;

R'_l is the linear thermal resistance of the insulation;

R_E is the linear thermal resistance of the ground for a pipe laid in homogeneous soil;

λ_E is the design thermal conductivity of the ambient soil;

H_E is the distance between the centre of the pipe and the ground surface.

The linear thermal resistance of the ground for an uninsulated pipe, as shown in Figure 11, is given by Equation (74):

$$R_E = \frac{1}{2\pi\lambda_E} \operatorname{arcosh} \frac{2H_E}{D_i} \quad (74)$$

which, for $H_E/D_i > 2$, may be simplified to Equation (75):

$$R_E = \frac{1}{2\pi\lambda_E} \ln \frac{4H_E}{D_i} \quad (75)$$

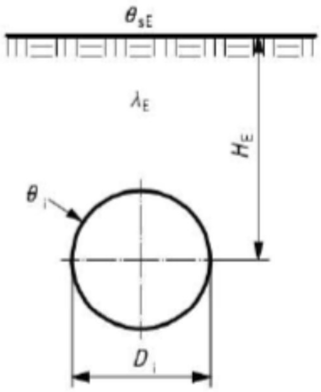
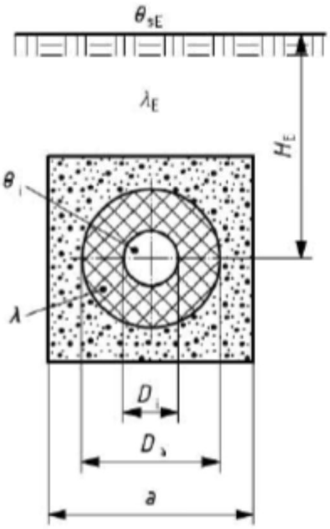


Figure 11 — Underground pipe without insulation

8.2.2 Insulated pipe

For underground pipes with insulating layers, as shown in Figure 12, the thermal resistance is calculated by Equation (76):

$$R'_{\mathrm{l}} = \frac{1}{2\pi} \sum_{j=1}^{n} \left(\frac{1}{\lambda_j} \ln \frac{D_{\mathrm{e}j}}{D_{\mathrm{i}j}} \right) \tag{76}$$



NOTE The concentric layers can consist of, for example, insulating material and sheathing (e.g. jacket pipe) embedded in a bottoming (e.g. sand) with a square cross-section.

Figure 12 — Underground pipe comprising several concentric layers

The square cross-section of the outer layer with side length, a, is taken into consideration with an equivalent diameter as given by Equation (77):

$$D_n = 1{,}073 \times a \tag{77}$$

The internal diameter, D_i, is identical to D_0 (where $j = 1$). The linear thermal resistance of the ground, R_E, becomes, in this case, as given by Equation (78):

$$R_E = \frac{1}{2\,\pi\,\lambda_E} \text{arcosh} \frac{2\,H_E}{D_n} \tag{78}$$

which, for $H_E/D_n > 2$, may be simplified to Equation (79):

$$R_E = \frac{1}{2\,\pi\,\lambda_E} \ln \frac{4\,H_E}{D_n} \tag{79}$$