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# Energy saving and emission reduction at the sugar-plant with take into acount of condensate heat of return steam in process integration

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The case study in this paper is presented for sugar plant with output 3000 tons of sugar-beet per day. The flowsheet of the production is typical one for Russia and Ukraine and includes the continue convection process with the press water return, the limed – carbonic cleaning of convection juice (which consist of progressive preliming, hot and cold main liming, first saturation, filtering, liming before second saturation, second saturation and sulfitation), the juice thickening by evaporation and three stage of crystallization with of third crystallization sugar affination.

The process of beet-sugar production on the investigated plant consists of three technologically and regionally separated parts: beet-sugar processing, juice purification and product stage. Earlier in papers [1 – 3] we presented the heat integration of the beet-sugar processing and juice purification stages with the partial inclusion into integration the product stage technological streams. As a result 23 streams was included in the integration but without stream of return steam condensate.

The analysis of existing heat exchanger network at the plant and its features were submitted in the work [1]. Here we shall note, that before retrofit heat exchanger network $\Delta ?_{min}$ in the manufacture of sugar was equal 8,5°? , and consumption of the return steam was ~ 72 kg on 100 kg of processed beet. After inclusion in heat integration of the greater number of technological streams the flowsheet in which $\Delta ?_{min}$ = 2,5°? and consumption of the return steam on 16 % less was offered.

In the middle geographical latitudes of Russia and Ukraine where basically sugar plants are located, the great value has fuller integration of heat streams at the industrial plants. For example, processing sugar beet campaign lasts 3-4 months, since September till January inclusive. At this time the air temperature may fall to -30°? and lower, and it results in big convective thermal losses in environment from steam and condensate mains. Decrease of return steam values and accordingly its condensate, and also temperature fall of the condensate returned in utility system may result in significant energy saving and pollution reduction at the sugar plants located in the middle latitudes. The analysis of several plants' work has shown, that only steam main have good thermal isolation, but condensate main pipelines don't have qualitative thermal isolation. The length of these main pipelines in open air may achieve 500 and more meters. Therefore we have offered to use return stem condensate heat in the heat integration at the examined plant.

It is impossible to make direct integration of return steam condensate heat into heat network of sugar-plant as we have made in early work [1]. Really, if we included the heat energy containing in condensate of return steam into plant recuperation system we would satisfy partially energy demands for cold streams and it would lead to utility consumption decrease, i.e. return steam consumption – $Q_{Hmin}$ decreases. As the result mass flowrate of return steam condensate decrease and so on. To overcome this problem we elaborate the method which allows to integrate the return steam condensate stream into heat energy system of sugar plant without iterative procedure. This method allows to decrease energy consumption on some more percents in comparison with the result of early paper [1].

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