EFFECTIVE AND ECONOMIC SUNFLOWER SEEDS DRYING

I.P.Slobodyanik

350072, Krasnodar, Moscow Street, 2. Kuban State Technological University,

(Russia).

SUMMARY

For effective and economic sunflower seeds drying a drying installation, consisting of top cylindrical fluidized-bed drier and bottom cylindrical shaft drier, is offered. Between top and bottom driers an intermediate bunker for lying down of drying material is located. A cooling chamber is located under the bottom drier. The top drier is executed in a kind of located in layers on height central and peripheral funnels. Bottom shaft drier is executed in a kind of concentric cylinders with perforations for drying agent passing into a layer of the drying material.

INTRODUCTION

For mass-exchange intensification in drying conditions the drying material is directed by opposite current from top to bottom at the first into the top fluidized-bed drier, and then into the bottom shaft drier. The drying agent moves from bottom to top and contacts with drying material by cross current in the bottom shaft drier and by opposite current in the top drier. In the top drier by high drying agent and sunflower seeds speeds a surface moisture is driven away in fluidizing conditions. In the bottom shaft drier an internal hygroscopic moisture is driven away by small linear speeds of the drying agent in the drying material layer.

DESCRIPTION OF DRYING INSTALLATION

The drying installation includes (fig.1) the drier with a fluidized layer of loose material in a kind of a vertical cylindrical case 1 with located in layers in it alternated with each other central funnels 2,

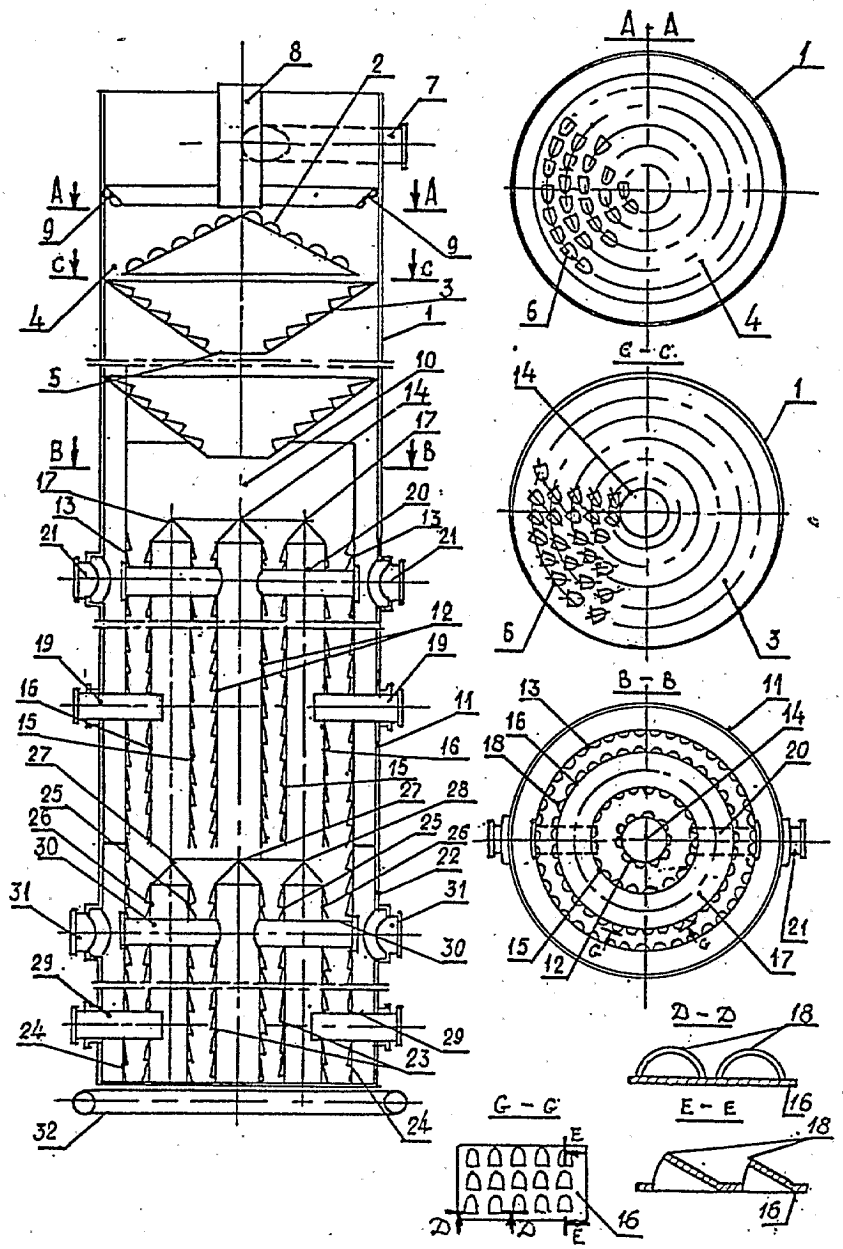

Fig.1. Drying installation for sunflower seeds drying.

executed in a kind of direct perforated cones, these cones being oriented upwards by their tops and established axis-symmetrically in cylindrical case 1, peripheral funnels 3 in a kind of truncated cones, oriented by large basis upwards, contiguous to the walls of the case 1, peripheral ring overlaps 4 of the central funnels 2 and central overlaps 5 of the peripheral funnels 3. An inclination corner to horizontal of central funnels 3 forming lines is less than an inclination corner of peripheral funnels 3 forming lines, both these corners being more than a corner of natural slope of the drying loose material. The perforations of the funnels for passage of the drying agent are executed in a kind of arch slots 6 with their protuberances upwards, located in concentric circles in relation to funnels axes. The direction of arch slots 6 axes is tangential on the central funnels 2 and by a sharp corner to the forming lines from periphery to centre on the peripheral funnels 3. A branch pipe 7 for the drying agent drawing away is connected to the top part of the case 1 tangentially to this case. The direction of the branch pipe 7 coincides with the tangential direction of the arch slots 6 axes in the central funnels 2. In the top part of fluidized-bed drier a central branch pipe 8 for the drying material input is installed axis-symmetrically to the case 1. The installation is supplied with before-drying bunker, noria for the drying material submission from before-drying bunker to the branch pipe 8. A reflecting truncated perforated cone 9 is installed below the top branch pipe 7 for the drying agent drawing away from the fluidized-0bed drier 1, the cone being oriented upwards by its large foundation, which is contiguous to the walls of the case 1, and having arch slots 6, executed by their protuberances downwards. The axes of the arch slots 6 coincide with direction of arch slots 6 axes in the central funnels 2. The top outlet branch pipe 7 for the drying agent removal is connected with the inlet tangential branch pipe of a cyclone and the outlet central branch pipe of the cyclone is connected to a soaking branch pipe of an exhaust fan. The funnels 2 and 3 are fastened one to another by tension members. The funnels 3 are fastened to the walls of the case 1. Under the fluidized-bed drier 1 an intermediate bunker 10 for drying material lying down is located. Under the bunker 10 the shaft drier 11 is located, which is executed in a kind of a vertical cylindric case, inside of which two perforated cylinders: internal 12 and external 13 - are concentrically installed. A cone 14, oriented by its top upwards, is installed over the internal cylinder 12. Between internal 12 and the external 13

cylinders internal intermediate 15 and external 16 cylinders are concentrically located, conic ring two-ramped overlap 17 being located over them. Top edges of the external cylinder 13 are located higher than the smaller foundation of the most bottom peripheral funnel 3 of the fluidized-bed drier 1. Perforation of the cylinders 12, 13 and 15, 16 are executed in a kind of arch slots 18 by their protuberances outwards for the cylinders 12, 16 and by their protuberances inwards for the cylinders 13 and 15.

The diameters of the cylinders 12, 13, 15, 16 are accepted by such a matter, that the ring section between the cylinders 15 and 16 was equal to ring section between the case 11 and the cylinder 13, proceeding from an equation of the continuity of flows. Arch slots 18 are directed by their axes from top to bottom for solid particles of drying material passing through them prevention, at the same time the drying agent movement through the slots 18 in the same direction, as drying material movement, occurs. Branch pipes 19 are ibrought into the ring space between the cylinders 15 and 16, which are connected with forcing branch pipe of a fan, connected by means of a soaking branch pipe with a furnace. The internal space of a cylinder 12 is connected with the ring space between the cylindrical case 11 and the external cylinder 13 by means of radial branch pipes 20. The diameter of the cylinder 13 at the level of branch pipes 20 decreases so that the ring section between the case 11 and the cylinder 13 increases in two times for the whole volume of the drying agent admitting, proceeding from an equation of the continuity of flows. On the opposite side to branch pipes 20 in the case 11 hatches 21 for an opportunity of branch pipes 20 installation and dismantling are established. Under the case 11 of the shaft drier a cooling chamber 22, executed in a kind of cylindrical case, is installed; inside of the case internal 23 and external 24 perforated cylinders are located, and between the cylinders 23 and 24 the internal intermediate 25 and the external intermediate 26 perforated cylindersare located. A cone 27 is installed over the internal cylinder 23 by its top upwards, conic ring two-ramped overlap 28 being installed over the cylinders 25 and 26.The perforation of the cylinders 23, 24, 25, 26 are executed in a kind of arch slots 18 as well as in appropriate cylinders 12, 13 and 15, 16 of shaft drier 11. Into the ring space between cylinders 26 and 25 branch pipes 29, connected with forcing branch pipe of a fan, are brought, the soaking branch pipe of which is connected with atmosphere. The internal space of the

internal cylinder 23 is connected with the ring space between the case of the cooling chamber 22 and the external cylinder 24 by radial branch pipes 30. Branch pipe 31 is connected to the case of the cooling chamber 22, which is also connected by means of pipe with the furnace. The branch pipes 30 can be installed and dismantled also through the branch pipes 31.

The branch pipes 31 are connected to the case 22 of cooling chamber through the broadening chamber for maintenance of sufficient cross section, equal to the cross section of the branch pipe 31 by the height of the broadening chamber, equal to 0,25th part of branch pipe 31 diameter. Under the cooling chamber 22 an outlet gear for proportioned unloading of dried and cooled loose material is installed. The intermediate bunker 10 is supplied by gauges of the bottom and top drying material levels in a bunker, blocked with a starting device of unloading gear 32 for agreed continuous mode of fluidized-bed drier 1 and shaft drier operation, so at the overflow of a intermediate bunker 10 passing of the drying agent through the drier 1 stops, so the shaft drier also stops its work, because the drying agent passes consistently through both driers.

The drying installation works as follows.

The loose material is given by the noria (fig.1) into the before-drying bunker, from which by means of screw the material is given through the branch pipe 6 into the drier 1 with fluidized layer of drying loose material, where it is poured in turn from the central funnel 2, on which the material is driven from a centre to a periphery under the action of centrifugal forces in conditions of a regularly rotating two-phase gas and loose material flow. In the peripheral part of the central funnel 2 the material is poured through the ring overlap 4 to the peripheral part of the peripheral funnel 3, where due to the inclination corner between the horizontal surface and the forming lines of the funnel 3 more than the corner of natural slope of drying loose material this material is poured from the periphery to the centre and through the central overlap 5 is poured into the centre of located below central funnel 2 and etc.

On central 2 and peripheral 3 funnels the drying material interacts with the hot drying agent, driving from bottom to top through arch slots 6 of the funnels 2 and 3 of the drier 1 with fluidized layer; at the same time high-speed heat-and-mass-exchange between the drying agent and damp material and removal of a surface moisture occurs. At this time the speed of the drying agent makes about 2-3

metres per second in complete drier section, and the speed of a jet at the exit from the arch slots on the average makes 15-20 metres per second.with. It is known, that in the first period of drying at surface moisture removal speed of the drying agent is the determining parameter of drying speed. Therefore for surface moisture removal the fluidized-bed dryer is most acceptable, which provides maximum thermal efficiency of the drier. After the removal of the surface moisture in the drier 1 the drying material arrives into the intermediate bunker 10, where it is continuously poured into the volumes between the external cylinder 13 and external additional cylinder 16 and between internal additional cylinder 15 and internal cylinder 12 of the shaft drier 11, where it is blown by the hot drying agent, submitted from the furnace by a fan through the branch pipe 19. Thus the drying agent passes through the ring space between cylinders 16 and 15 through the arch slots 18 in the walls of cylinders 15 and 16 into the layer of the drying material. In the shaft drier 11 the speed of the drying agent passing through the layer of loose material in recalculation for complete section makes from 0,1 up to 0,3 metres per second , and the thickness of the layer of the loose material is equal on the average from 0,1 up to 0,4 metres. Thus in the shaft drier 11 speed of the drying agent on the average is by an order of magnitude less, than in fluidized-bed drier.

The increase of efficiency and profitability of installation for loose materials drying is provided for the account of high-efficient convection external transfer of moisture from the surface of the material in the drier 1 with fluidized layer. In the shaft drier 11 the drying agent is about 2 seconds and its temperature is lowered slightly, and, consequently, its thermal potential before submittion into the fluidized-bed drier 1 remains high.

KEY WORDS:

Effective and economic drying, sunflower seeds, drying with fluidized layer, shaft drier, opposite current, drying agent, thermal efficiency of the drier.