

ANEXO 10. Resultados centrifuga 4

$$A_{\text{interna,tubería}} = 0,0009621 \text{ [m}^2\text{]}$$

$$D_{\text{interno,tubería}} = 0,035 \text{ [m]}$$

$$\eta_{\text{bomba,motor}} = 0,8$$

$$g = 9,82 \text{ [m/s}^2\text{]}$$

$$h_{\text{nivel,tanque,crítico}} = 0,5 \text{ [m]}$$

$$h_{\text{perdida,menor1}} = 0,7565 \text{ [m]}$$

$$K_{\text{codos}} = 0,3$$

$$K_{\text{tee}} = 1$$

$$K_{\text{val,ángulo}} = 5$$

$$L_{2,C4} = 18,3 \text{ [m]}$$

$$L_{\text{equ,salida,suave}} = 0,05531 \text{ [m]}$$

$$L_{\text{equ,val,bola}} = 0,06913 \text{ [m]}$$

$$\mu = 0,0009112 \text{ [kg/m-s]}$$

$$P_{\text{adm,Centrífuga}} = 100000 \text{ [Pa]}$$

$$P_{\text{Medellín}} = 85113 \text{ [Pa]}$$

$$Q = 0,001111 \text{ [m}^3\text{/s]}$$

$$Re = 44241$$

$$T = 24 \text{ [}^{\circ}\text{C]}$$

$$V_{\text{fluido}} = 1,155 \text{ [m/s]}$$

$$V_{\text{requerido}} = 0,03333 \text{ [m}^3\text{]}$$

$$V_{\text{tramo1}} = 0,01693 \text{ [m}^3\text{]}$$

$$V_{\text{tramos}} = 0,03454 \text{ [m}^3\text{]}$$

$$\dot{W}_{\text{eléctrica}} = 20,1 \text{ [W]}$$

$$Z_1 = 0,5 \text{ [m]}$$

$$D_h = 0,035 \text{ [m]}$$

$$\varepsilon = 0,000051 \text{ [m]}$$

$$f_{\text{fricción}} = 0,02531$$

$$h_{\text{bomba}} = 14,51 \text{ [m]}$$

$$h_{\text{perdida,mayor1}} = 0,8644 \text{ [m]}$$

$$h_{\text{total1}} = 1,621 \text{ [m]}$$

$$K_{\text{salida,suave}} = 0,04$$

$$K_{\text{val,bola}} = 0,05$$

$$L_{1,C4} = 17,6 \text{ [m]}$$

$$L_{\text{equ,codos}} = 0,4148 \text{ [m]}$$

$$L_{\text{equ,tee}} = 1,383 \text{ [m]}$$

$$L_{\text{equ,val,ángulo}} = 6,913 \text{ [m]}$$

$$P_1 = 90010 \text{ [Pa]}$$

$$P_{\text{fluido}} = 185113 \text{ [Pa]}$$

$$P_{\text{mojado}} = 0,11 \text{ [m]}$$

$$Q_{\text{litros}} = 4000 \text{ [l/h]}$$

$$\rho = 997,3 \text{ [kg/m}^3\text{]}$$

$$t_{\text{refrigeración}} = 30 \text{ [s]}$$

$$V_{\text{recorrido,completo}} = 0,05254 \text{ [m}^3\text{]}$$

$$V_{\text{tambor}} = 0,018 \text{ [m}^3\text{]}$$

$$V_{\text{tramo2}} = 0,01761 \text{ [m}^3\text{]}$$

$$\dot{V} = 0,001111 \text{ [m}^3\text{/s]}$$

$$\dot{W}_{\text{hp}} = 0,02696 \text{ [hp]}$$

$$Z_2 = 3,68 \text{ [m]}$$

ANEXO 11. Resultados centrifuga 5

$$A_{\text{interna,tubería}} = 0,0009621 \text{ [m}^2\text{]}$$

$$D_{\text{interno,tubería}} = 0,035 \text{ [m]}$$

$$\eta_{\text{bomba,motor}} = 0,8$$

$$g = 9,82 \text{ [m/s}^2\text{]}$$

$$h_{\text{nivel,tanque,critico}} = 0,5 \text{ [m]}$$

$$h_{\text{perdida,menor1}} = 0,7565 \text{ [m]}$$

$$K_{\text{codos}} = 0,3$$

$$K_{\text{tee}} = 1$$

$$K_{\text{val,ángulo}} = 5$$

$$L_{2,C5} = 20,4 \text{ [m]}$$

$$L_{\text{equ,salida,suave}} = 0,05531 \text{ [m]}$$

$$L_{\text{equ,val,bola}} = 0,06913 \text{ [m]}$$

$$\mu = 0,0009112 \text{ [kg/m-s]}$$

$$P_{\text{adm,Centrifuga}} = 100000 \text{ [Pa]}$$

$$P_{\text{Medellín}} = 85113 \text{ [Pa]}$$

$$Q = 0,001111 \text{ [m}^3\text{/s]}$$

$$Re = 44241$$

$$T = 24 \text{ [}^\circ\text{C]}$$

$$V_{\text{fluido}} = 1,155 \text{ [m/s]}$$

$$V_{\text{olrequerido}} = 0,03333 \text{ [m}^3\text{]}$$

$$V_{\text{oltramo1}} = 0,02078 \text{ [m}^3\text{]}$$

$$V_{\text{oltramos}} = 0,04041 \text{ [m}^3\text{]}$$

$$\dot{W}_{\text{eléctrica}} = 20,37 \text{ [W]}$$

$$Z_1 = 0,5 \text{ [m]}$$

$$D_h = 0,035 \text{ [m]}$$

$$\varepsilon = 0,000051 \text{ [m]}$$

$$f_{\text{fricción}} = 0,02531$$

$$h_{\text{bomba}} = 14,71 \text{ [m]}$$

$$h_{\text{perdida,mayor1}} = 1,061 \text{ [m]}$$

$$h_{\text{total1}} = 1,817 \text{ [m]}$$

$$K_{\text{salida,suave}} = 0,04$$

$$K_{\text{val,bola}} = 0,05$$

$$L_{1,C5} = 21,6 \text{ [m]}$$

$$L_{\text{equ,codos}} = 0,4148 \text{ [m]}$$

$$L_{\text{equ,tee}} = 1,383 \text{ [m]}$$

$$L_{\text{equ,val,ángulo}} = 6,913 \text{ [m]}$$

$$P_1 = 90010 \text{ [Pa]}$$

$$P_{\text{fluido}} = 185113 \text{ [Pa]}$$

$$P_{\text{mojado}} = 0,11 \text{ [m]}$$

$$Q_{\text{litros}} = 4000 \text{ [l/h]}$$

$$\rho = 997,3 \text{ [kg/m}^3\text{]}$$

$$t_{\text{refrigeración}} = 30 \text{ [s]}$$

$$V_{\text{olrecorrido,completo}} = 0,05841 \text{ [m}^3\text{]}$$

$$V_{\text{oltambor}} = 0,018 \text{ [m}^3\text{]}$$

$$V_{\text{oltramo2}} = 0,01963 \text{ [m}^3\text{]}$$

$$\dot{V} = 0,001111 \text{ [m}^3\text{/s]}$$

$$\dot{W}_{\text{hp}} = 0,02732 \text{ [hp]}$$

$$Z_2 = 3,68 \text{ [m]}$$

ANEXO 12. Resultados centrífuga 6

$$A_{\text{interna,tubería}} = 0,0009621 \text{ [m}^2\text{]}$$

$$D_{\text{interno,tubería}} = 0,035 \text{ [m]}$$

$$\eta_{\text{bomba,motor}} = 0,8$$

$$g = 9,82 \text{ [m/s}^2\text{]}$$

$$h_{\text{nivel,tanque,crítico}} = 0,5 \text{ [m]}$$

$$h_{\text{perdida,menor1}} = 0,7565 \text{ [m]}$$

$$K_{\text{codos}} = 0,3$$

$$K_{\text{tee}} = 1$$

$$K_{\text{val,ángulo}} = 5$$

$$L_{2,C6} = 22,2 \text{ [m]}$$

$$L_{\text{equ,salida,suave}} = 0,05531 \text{ [m]}$$

$$L_{\text{equ,val,bola}} = 0,06913 \text{ [m]}$$

$$\mu = 0,0009112 \text{ [kg/m-s]}$$

$$P_{\text{adm,Centrífuga}} = 100000 \text{ [Pa]}$$

$$P_{\text{Medellín}} = 85113 \text{ [Pa]}$$

$$Q = 0,001111 \text{ [m}^3\text{/s]}$$

$$Re = 44241$$

$$T = 24 \text{ [}^\circ\text{C]}$$

$$V_{\text{el fluido}} = 1,155 \text{ [m/s]}$$

$$V_{\text{ol requerido}} = 0,03333 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramo1}} = 0,0204 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramos}} = 0,04176 \text{ [m}^3\text{]}$$

$$\dot{W}_{\text{eléctrica}} = 20,35 \text{ [W]}$$

$$Z_1 = 0,5 \text{ [m]}$$

$$D_h = 0,035 \text{ [m]}$$

$$\varepsilon = 0,000051 \text{ [m]}$$

$$f_{\text{fricción}} = 0,02531$$

$$h_{\text{bomba}} = 14,69 \text{ [m]}$$

$$h_{\text{perdida,mayor1}} = 1,041 \text{ [m]}$$

$$h_{\text{total1}} = 1,798 \text{ [m]}$$

$$K_{\text{salida,suave}} = 0,04$$

$$K_{\text{val,bola}} = 0,05$$

$$L_{1,C6} = 21,2 \text{ [m]}$$

$$L_{\text{equ,codos}} = 0,4148 \text{ [m]}$$

$$L_{\text{equ,tee}} = 1,383 \text{ [m]}$$

$$L_{\text{equ,val,ángulo}} = 6,913 \text{ [m]}$$

$$P_1 = 90010 \text{ [Pa]}$$

$$P_{\text{fluido}} = 185113 \text{ [Pa]}$$

$$P_{\text{mojado}} = 0,11 \text{ [m]}$$

$$Q_{\text{litros}} = 4000 \text{ [l/h]}$$

$$\rho = 997,3 \text{ [kg/m}^3\text{]}$$

$$t_{\text{refrigeración}} = 30 \text{ [s]}$$

$$V_{\text{ol recorrido,completo}} = 0,05976 \text{ [m}^3\text{]}$$

$$V_{\text{ol tambor}} = 0,018 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramo2}} = 0,02136 \text{ [m}^3\text{]}$$

$$\dot{V} = 0,001111 \text{ [m}^3\text{/s]}$$

$$\dot{W}_{\text{hp}} = 0,02728 \text{ [hp]}$$

$$Z_2 = 3,68 \text{ [m]}$$

ANEXO 13. Resultados centrifuga 7

$$A_{\text{interna,tubería}} = 0,0009621 \text{ [m}^2\text{]}$$

$$D_{\text{interno,tubería}} = 0,035 \text{ [m]}$$

$$\eta_{\text{bomba,motor}} = 0,8$$

$$g = 9,82 \text{ [m/s}^2\text{]}$$

$$h_{\text{nivel,tanque,crítico}} = 0,5 \text{ [m]}$$

$$h_{\text{perdida,menor1}} = 0,7565 \text{ [m]}$$

$$K_{\text{codos}} = 0,3$$

$$K_{\text{tee}} = 1$$

$$K_{\text{val,ángulo}} = 5$$

$$L_{2,C7} = 16,3 \text{ [m]}$$

$$L_{\text{equ,salida,suave}} = 0,05531 \text{ [m]}$$

$$L_{\text{equ,val,bola}} = 0,06913 \text{ [m]}$$

$$\mu = 0,0009112 \text{ [kg/m-s]}$$

$$P_{\text{adm,Centrífuga}} = 100000 \text{ [Pa]}$$

$$P_{\text{Medellín}} = 85113 \text{ [Pa]}$$

$$Q = 0,001111 \text{ [m}^3\text{/s]}$$

$$Re = 44241$$

$$T = 24 \text{ [}^\circ\text{C]}$$

$$V_{\text{el fluido}} = 1,155 \text{ [m/s]}$$

$$V_{\text{ol requerido}} = 0,03333 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramo1}} = 0,01424 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramos}} = 0,02992 \text{ [m}^3\text{]}$$

$$\dot{W}_{\text{eléctrica}} = 19,91 \text{ [W]}$$

$$Z_1 = 0,5 \text{ [m]}$$

$$D_h = 0,035 \text{ [m]}$$

$$\varepsilon = 0,000051 \text{ [m]}$$

$$f_{\text{fricción}} = 0,02531$$

$$h_{\text{bomba}} = 14,37 \text{ [m]}$$

$$h_{\text{perdida,mayor1}} = 0,7269 \text{ [m]}$$

$$h_{\text{total1}} = 1,483 \text{ [m]}$$

$$K_{\text{salida,suave}} = 0,04$$

$$K_{\text{val,bola}} = 0,05$$

$$L_{1,C7} = 14,8 \text{ [m]}$$

$$L_{\text{equ,codos}} = 0,4148 \text{ [m]}$$

$$L_{\text{equ,tee}} = 1,383 \text{ [m]}$$

$$L_{\text{equ,val,ángulo}} = 6,913 \text{ [m]}$$

$$P_1 = 90010 \text{ [Pa]}$$

$$P_{\text{fluido}} = 185113 \text{ [Pa]}$$

$$P_{\text{mojado}} = 0,11 \text{ [m]}$$

$$Q_{\text{litros}} = 4000 \text{ [l/h]}$$

$$\rho = 997,3 \text{ [kg/m}^3\text{]}$$

$$t_{\text{refrigeración}} = 30 \text{ [s]}$$

$$V_{\text{ol recorrido,completo}} = 0,04792 \text{ [m}^3\text{]}$$

$$V_{\text{ol tambor}} = 0,018 \text{ [m}^3\text{]}$$

$$V_{\text{ol tramo2}} = 0,01568 \text{ [m}^3\text{]}$$

$$\dot{V} = 0,001111 \text{ [m}^3\text{/s]}$$

$$\dot{W}_{\text{hp}} = 0,0267 \text{ [hp]}$$

$$Z_2 = 3,68 \text{ [m]}$$

ANEXO 14. Resultados centrifuga 8

$$A_{\text{interna,tubería}} = 0,0009621 \text{ [m}^2\text{]}$$

$$D_{\text{interno,tubería}} = 0,035 \text{ [m]}$$

$$\eta_{\text{bomba,motor}} = 0,8$$

$$g = 9,82 \text{ [m/s}^2\text{]}$$

$$h_{\text{nivel,tanque,critico}} = 0,5 \text{ [m]}$$

$$h_{\text{perdida,menor1}} = 0,7565 \text{ [m]}$$

$$K_{\text{codos}} = 0,3$$

$$K_{\text{tee}} = 1$$

$$K_{\text{val,ángulo}} = 5$$

$$L_{2,C8} = 17,9 \text{ [m]}$$

$$L_{\text{equ,salida,suave}} = 0,05531 \text{ [m]}$$

$$L_{\text{equ,val,bola}} = 0,06913 \text{ [m]}$$

$$\mu = 0,0009112 \text{ [kg/m-s]}$$

$$P_{\text{adm,Centrífuga}} = 100000 \text{ [Pa]}$$

$$P_{\text{Medellín}} = 85113 \text{ [Pa]}$$

$$Q = 0,001111 \text{ [m}^3\text{/s]}$$

$$Re = 44241$$

$$T = 24 \text{ [}^\circ\text{C]}$$

$$V_{\text{fluido}} = 1,155 \text{ [m/s]}$$

$$V_{\text{requerido}} = 0,03333 \text{ [m}^3\text{]}$$

$$V_{\text{tramo1}} = 0,01818 \text{ [m}^3\text{]}$$

$$V_{\text{tramos}} = 0,03541 \text{ [m}^3\text{]}$$

$$\dot{W}_{\text{eléctrica}} = 20,19 \text{ [W]}$$

$$Z_1 = 0,5 \text{ [m]}$$

$$D_h = 0,035 \text{ [m]}$$

$$\varepsilon = 0,000051 \text{ [m]}$$

$$f_{\text{fricción}} = 0,02531$$

$$h_{\text{bomba}} = 14,58 \text{ [m]}$$

$$h_{\text{perdida,mayor1}} = 0,9282 \text{ [m]}$$

$$h_{\text{total1}} = 1,685 \text{ [m]}$$

$$K_{\text{salida,suave}} = 0,04$$

$$K_{\text{val,bola}} = 0,05$$

$$L_{1,C8} = 18,9 \text{ [m]}$$

$$L_{\text{equ,codos}} = 0,4148 \text{ [m]}$$

$$L_{\text{equ,tee}} = 1,383 \text{ [m]}$$

$$L_{\text{equ,val,ángulo}} = 6,913 \text{ [m]}$$

$$P_1 = 90010 \text{ [Pa]}$$

$$P_{\text{fluido}} = 185113 \text{ [Pa]}$$

$$P_{\text{mojado}} = 0,11 \text{ [m]}$$

$$Q_{\text{litros}} = 4000 \text{ [l/h]}$$

$$\rho = 997,3 \text{ [kg/m}^3\text{]}$$

$$t_{\text{refrigeración}} = 30 \text{ [s]}$$

$$V_{\text{recorrido,completo}} = 0,05341 \text{ [m}^3\text{]}$$

$$V_{\text{tambor}} = 0,018 \text{ [m}^3\text{]}$$

$$V_{\text{tramo2}} = 0,01722 \text{ [m}^3\text{]}$$

$$\dot{V} = 0,001111 \text{ [m}^3\text{/s]}$$

$$\dot{W}_{\text{hp}} = 0,02707 \text{ [hp]}$$

$$Z_2 = 3,68 \text{ [m]}$$

ANEXO 15. Esquema de tuberías de entrada para las centrífugas

A continuación se muestra un esquema del lugar exacto donde se pueden instalar las tuberías en cada una de las centrífugas, la tubería de *Recirculación* viene desde el tanque de almacenamiento.



Imagen 40. Tubería de entrada centrífuga #4



Imagen 41. Tubería de entrada centrífuga #5



Imagen 42. Tubería de entrada centrífuga #6



Imagen 43. Tubería de entrada centrífuga #7

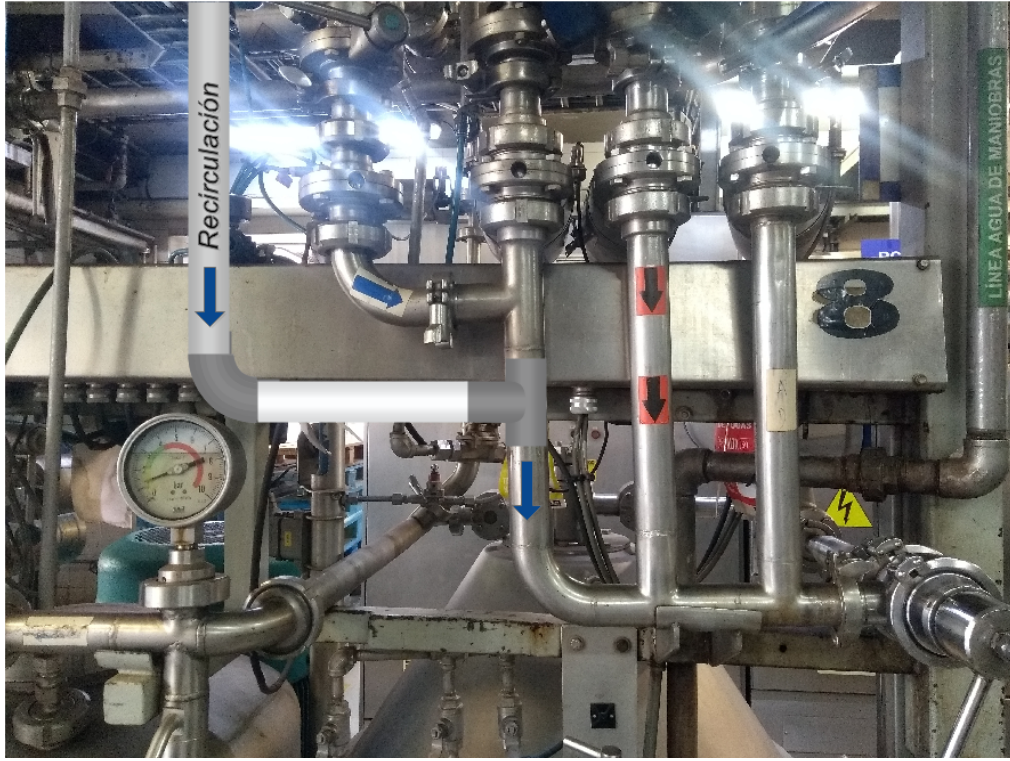


Imagen 44. Tubería de entrada centrífuga #8

ANEXO 16. Esquema de tuberías de salida de las centrifugas

A continuación se muestra un esquema del lugar exacto donde se pueden instalar las tuberías en cada una de las centrifugas, la tubería de *Regreso a tanque* sale de cada centrifuga y regresa al tanque de almacenamiento.

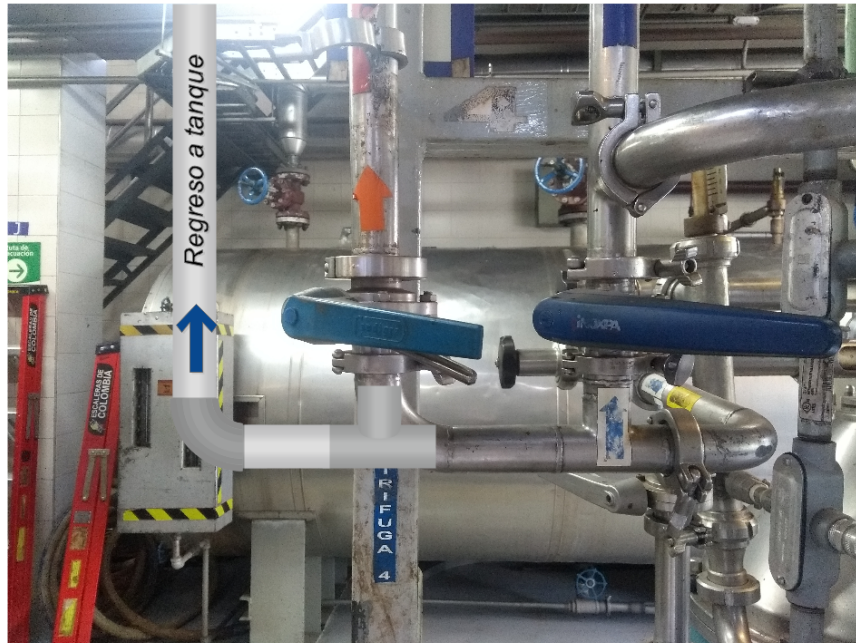


Imagen 45. Tubería de salida centrifuga #4



Imagen 46. Tubería de salida centrifuga #5

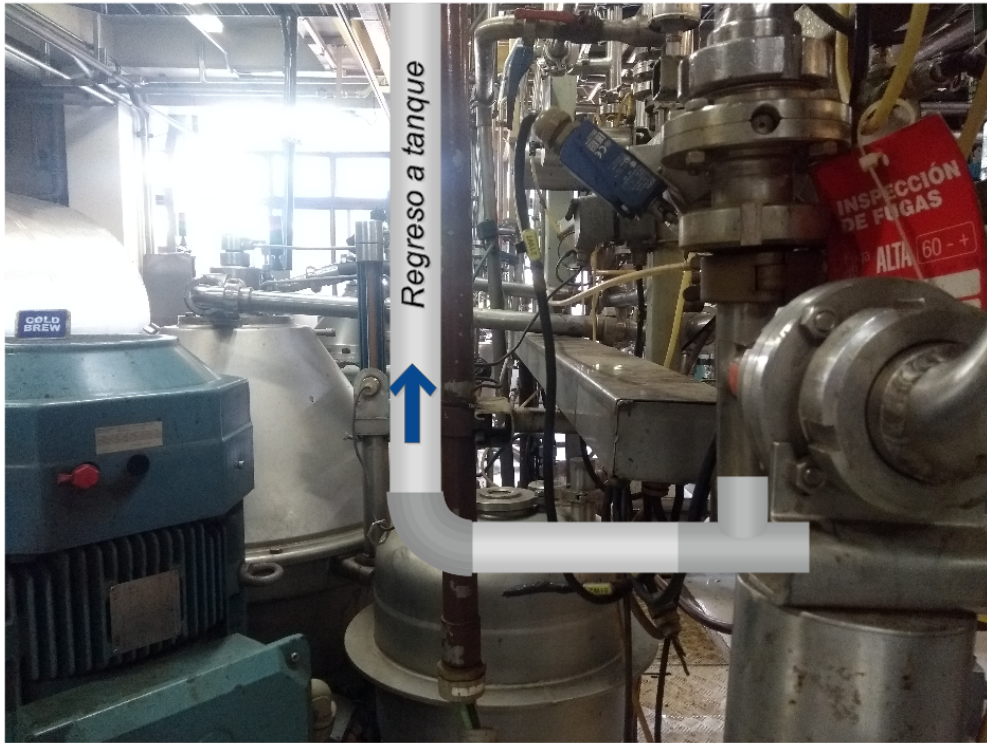


Imagen 47. Tubería de salida centrífuga #6



Imagen 48. Tubería de salida centrífuga #7

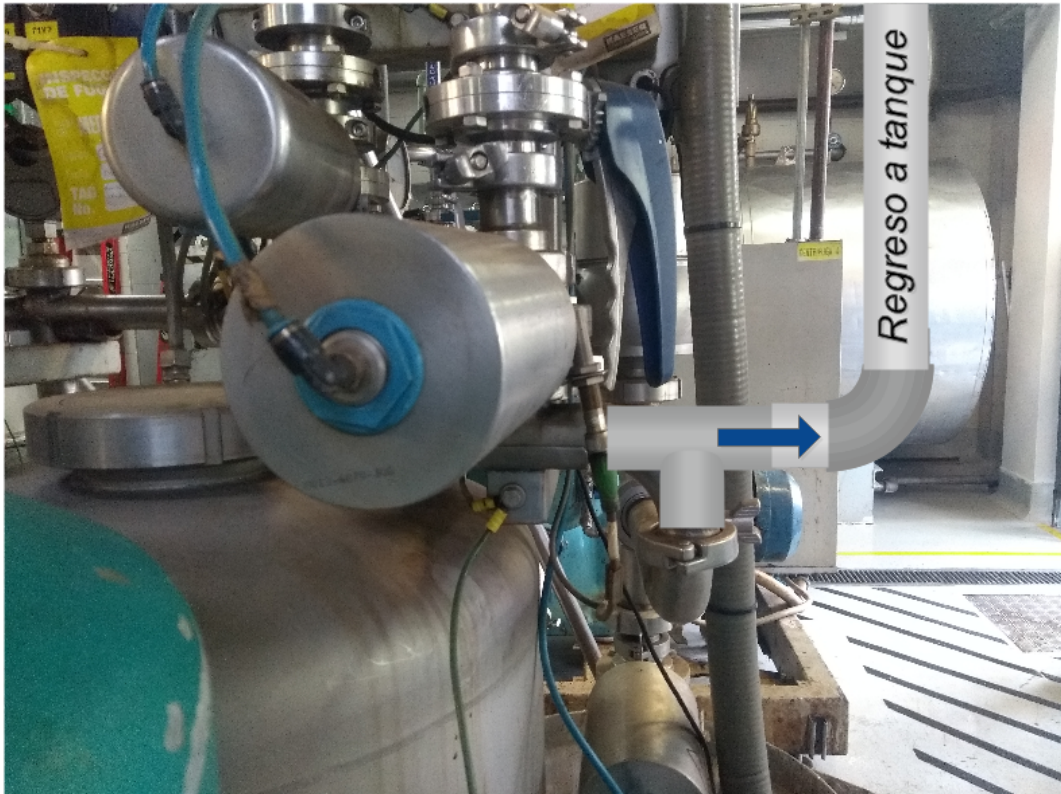


Imagen 49. Tubería de salida centrífuga #8