Monsanto COMPANY

LOCATION GROUND LEVEL

CENTRIFUGAL PUMP PERFORMANCE DATA

PROJ/DEPT 811.00

EQUIP. IDENT NO. 419
AUTH NO. 1800 PLANT W6K
BY RSYATES DATE 10-16-67
APPD SHEET 1 OF 1

NAME CHLORINATOR No 9 CIRCULATING PUMP NO. REQD 1

FUNCTION CIRCULATE CONTENTS OF CHLORINATOR THROUGH EXTERNAL COOLER (ITEM 420) AND RETURN TO CHLORINATOR

OPERATION CONTINUOUS AFTER START

DUTY: ☐ INTERMITTENT ☒ CONTINUOUS HOURS PER YEAR

MATERIALS HANDLED

	COMPONENT	UNITS	NORMAL	DESIGN	REMARKS
LIQUID	AROCLOR 1242	GPM		250	
	TOTAL				
SOLIDS	$FeCl_3$	LB/MIN		0.1	
GAS					

PROCESS DATA

PUMPING TEMPERATURE, PT, °F 302 | SP GR @ PT 1.28 @ 60 F — | CRYSTALLIZING, TEMP °F —

VISCOSITY, 1.4 CPS (UNITS) @ PT — @ 60 F

VAPOR PRESSURE, PSIA, @ PT 0.16 @ 60 F — | SOLIDS — % WT | DENSITY — | SIZE —

CORROSION/EROSION: ☐ NEGLIGIBLE ☒ MODERATE ☐ SEVERE

ESTIMATED PERFORMANCE REQUIREMENTS

CAPACITY, USGPM: NORMAL 250 ; MAX DESIGN 250 ; CONTROL ALLOWANCE* NONE

PUMP RATED CAPACITY (MAXIMUM DESIGN CAPACITY PLUS CONTROL ALLOWANCE), USGPM, 250

STATIC HEAD @ PT, 26 FT — PSI | EQUIPMENT LOSS, PSI: 18 NORMAL — RATED

PIPE DIA, NPS: SUCTION 4" ; DISCHARGE 3" | PIPING LOSS, PSI: 10.7 NORMAL RATED

CONTROL VALVE PRESSURE DROP, PSI: 20.5 NORMAL | AVAILABLE NPSH, FT: 43.4 NORMAL — RATED

RATED TDH @ PT: 116 FT — PSI FROM PUMP CALCULATION SHEET NO. ES95

SYSTEM CURVE CALCULATIONS FROM SHEET NO. 7400 AV (DURCO) ; DRIVER ☒ ELEC MOTOR ☐ TURBINE ☐ OTHER

PUMP DATA

MATERIALS OF CONSTRUCTION:

CASING AND NOZZLES	DUCTILE IRON	PACKING	WOODS SPACER TYPE COUPLING (2)
IMPELLER	DUCTILE IRON	MECHANICAL SEAL	CHESTERTON
SHAFT, SHAFT SLEEVE	DCB	PACKING GLAND	YES
~~LINERS~~ BEARINGS	SEALED	BASE PLATE	TO ACCOMMODATE 30HP MOTOR
COUPLING GUARD PER SPEC D11.8 STD 2001			MONS SPEC D M.12 STD 10

CONSTRUCTION FEATURES REQUIRED FOR PROCESS OR PERFORMANCE CONSIDERATIONS:

1) 304L SS CATCH BASIN AT WET END OF PUMP
2) USE W6K STD PUMP - DURCO MARK II
3) USE W6K STD MOTOR - LINCOLN
4) JACKETED POWER PLATE AND STUFFING BOX
5) BASEPLATE TO BE PAINTED WITH MONS SPEC K1-3 STD 60

REMARKS, SPECS, TESTS, ETC.

PUMP: DURCO MARK II 3x2-13, AVS A30 1750 RPM

MOTOR: NON OVERLOADING ALARM ON SHUTDOWN

*Capacity in excess of maximum design for control purposes.

REV NO.	REVISION	BY	DATE	APPD	DATE
(1)	APPROVED FOR DESIGN	RSY	10-30-67		
(2)	ADDED COUPLING	RSY	11-7-67		
(3)					

ES 55 (7/67)

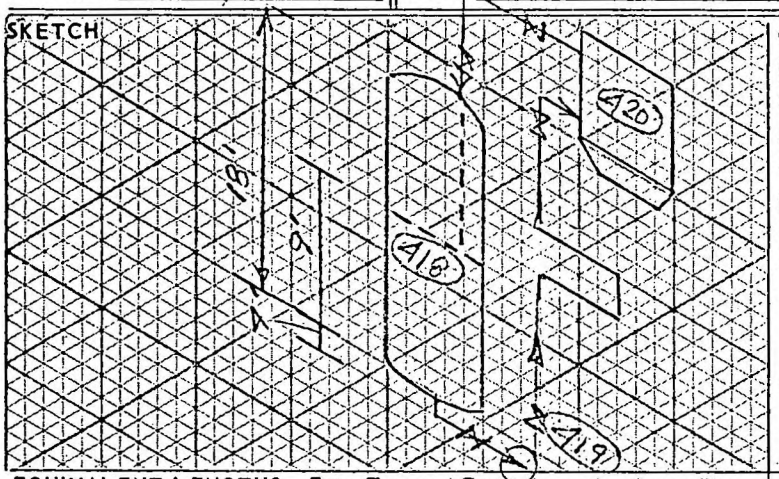
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Monsanto COMPANY

CENTRIFUGAL PUMP CALCULATION SHEET

EQUIP. NO. 419
AUTH NO. 1800 AREA NO. 1
PROJ/DEPT 511.03 BY R S YATES DATE 10-16-67
LOCATION GROUND LEVEL PLANT 116 KRUMRICK APPD. SHEET 1 OF 1

SKETCH



CONDITIONS

Material Pumped ARCLOR 1242
P.T. = Pumping Temperature 150 °C 302 °F
gpm = Flow Rate: Normal ____ Design 250
S = Specific Gravity* 1.28 Density 10.53 lb/gal
μ = Viscosity* 1.4 Centipoise
P_{vp} = Vapor Pressure* 4.5 mmHg ____ psia
ΔP: Control Valve ESTIMATED psi; Equip. 18 psi
Pipe (Material CARBON STEEL Sch or Wall Thk 40)
Nominal Size 4" Suction 3" Discharge
d, Actual ID, inches 4.026" Suction 3.068" Discharge
*At Pumping Temperature

EQUIVALENT LENGTHS Enter Type and Factor for each valve or fitting. Enter Number of each type, and line size. Multiply Factor × Size × Number and enter Feet equivalent length. See handbook for types not listed.

Factors for Valves (open) and Fittings					
Gate	1.1	Plug Valve	1.5	90° l. r. or Weld ell	1.7
Globe, Lift Check	28.0	Butterfly (6" & up)	1.7	Std Tee (on run)	1.7
Wye, Angle, Diaphr	14.0	90° Std Elbow	2.5	Std Tee (side out)	5.0
Swing Check	11.0	45° Std Elbow	1.3		

Suction					Discharge				
Type	Factor	Nominal Size, in.	Number	Feet	Type	Factor	Nominal Size, in.	Number	Feet
PLUG	1.5	4	1	6	PLUG	1.5	4	4	18
ELL	2.5	4	1	10	ELL	2.5	4	8	60
Length of straight pipe in feet				10					50
L = Total Equivalent Length, feet				26					128

FRICTION HEAD LOSS

$V = (0.408)\ gpm/d^2$, feet per second $\frac{.408 \times 250}{(4.03)^2} = \frac{.408 \times 250}{(3.07)^2}$
Re (Reynolds Number) $= (3162)\ gpmS/d\mu$ $\frac{(3162)(250)(1.28)}{(4)(1.4)}$
f = Friction Factor (See Appendix C of D14.2 Std 2) if Re < 2100 omit this step.
Δh [(Re < 2100) $= 0.154\ \mu V/d^2 S$; (Re > 2100) $= 18.63\ fV^2/d$] feet of fluid per 100 feet equivalent length $\frac{(18.63)(.0187) \times V^2}{d}$
Total Friction Head Loss = $\Delta h \times L/100 \times 1.15$ (safety factor), feet of fluid

	Suction	Discharge
	6.3	10.3
	180 000	236 000
	.0187	.0187
	3.4	13.3
	1	20

SUCTION AND DISCHARGE HEADS $\frac{19.7 \times 2.31}{1.28}$

	Suction	Discharge
Vessel Pressure (psia × 2.31/*S*)	(+) 35.4	(+) 35.4
Liquid Level (above pump +; below pump −)	(+) 9.0	
Static Head (above pump +; below pump −)		(+) 35.0
Total Friction Head Loss (Plus Velocity Head. See Note 4.)	(−) 1.0	(+) 20.0
Control Valve (Δpsi × 2.31/*S*) (See Notes 1 and 2)	(−) —	(+) 37.0
Orifice (Δpsi × 2.31/*S*) (See Note 2)	(−) —	(+) —
Equipment (Δpsi × 2.31/*S*) $18 \times 2.31/1.28$	(−) —	(+) 32.0
Suction Head Sum, feet of fluid, abs.	43.4	
Discharge Head Sum, feet of fluid, abs.		154.4

SYSTEM HORSEPOWER (estimated)

$HP = \frac{gpm \times TDH \times S}{3960 \times E \text{ (Note 3)}}$

$HP = \frac{250 \times 116 \times 1.28}{3960 \times 60\%}$

$HP = 15.6$

DYNAMIC HEAD

Discharge Head Sum 159.4
Suction Head Sum − 43.4
TDH = Total Dynamic Head, feet of fluid 116.0

NPSH

Suction Head Sum 43.4
P_{vp} (mmHg × 0.045/*S*) or (psia × 2.31/*S*) $\frac{.045 \times 4.5}{1.28}$ − —
NPSH Available, feet of fluid, abs. 43.4

PUMP SELECTION

Manufacturer DURCO MARK II; Model 3×2-13; Type AVS-A30
Speed 1750 rpm; Imp. Size 11 1/2; HP 20; Eff 60%;
GPM 250; TDH 116; NPSH 6 FT.

NOTES

1. Assume control valve loss to be 70% to 100% of piping plus equipment friction loss for initial calculation. Consult instrument engineer for final selection.
2. Control valves and orifices not normally used in pump suction.
3. Use combined efficiency of pump and drive.
4. See D14.2 STD 2, a guide for the use of this calculation procedure.

REV NO.	REVISION	BY	DATE	APPD	DATE
1					
2					
3					

ES 95 (1/66)

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