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1. Model Overview & Assumptions

1.1. Model overview

Provisor was contracted by the CSIRO to develop a wastewater model to provide information for wineries on the makeup and quantity of the wastewater they produce.

Two separate models were developed, one for small wineries and one for large. For each the following functionality has been included:

1. An input sheet used to gather general winery information including tonnes crushed, the way in which processing equipment is used and frequency of events that occur within the winery specifically related to water use. Each process unit contains operational activities that have been identified as contributing to water use.
2. An output sheet that calculates values of water use for specific operations (such as cleaning, push throughs, etc), the overall water use and waste water characteristics including pH, BOD, COD, ECC, TSS, Na and K for specific process units.
3. Output data are summarised in graphs that show the wastewater characteristics for each process unit. The graphs allow for a direct comparison between process units in terms of water volume and pollution load.
4. Reference data from a large and small winery. These data were obtained by extensive auditing of winery operations by CSIRO staff.

From the input data, the model predicts the contribution of process units to the total wastewater volume and load. Some operations might not apply to particular wineries in which case the input data can be left blank. This does not impact on the model calculations.

The model can also be used for estimating the impact of operational changes on the overall waste water quantity and load.

1.2. Assumptions & Basics of the Model

The model is based on audit work carried out as part of an extensive investigation into winery waste water by the CSIRO.

The data used to develop the large winery model was collected from Foster's Ryecroft processing centre in McLaren Vale. Data was collected from Turkey Flat in the Barossa to produce the small winery model.

2.1.1. Ryecroft

Ryecroft processes circa 50,000 tonnes fruit of which 50% is white and 50% red fruit. Two different sizes of crusher are used, small (2 tonnes) and large (8 tonnes). The average fermentation size is 15 tonnes. A range of different fermenter types are used including:

- Rotary;
- Sweeping Arm Potter (SWAP);
- Open top tanks;
- Jetting tanks for red wines; and
- Static tanks for whites.



1.2.1 Turkey Flat

Turkey Flat processes circa 450 tonnes fruit of which 280 tonnes is used to produce rose style wine. They also produce 110 tonnes of red wine with the remaining tonnes used to produce white wine. One crusher is in operation with a capacity of 5 tonnes. The average fermentation size is 5 tonnes. Fermentation is predominantly carried out in open top tanks with a pump over system employed.

2. Abbreviations used

1 COD = Chemical Oxygen Demand (mg.L^{-1})

EC = Electrical conductivity ($\mu\text{s.cm}^{-1}$)

TSS = Total Suspended Solids (mg.L^{-1})

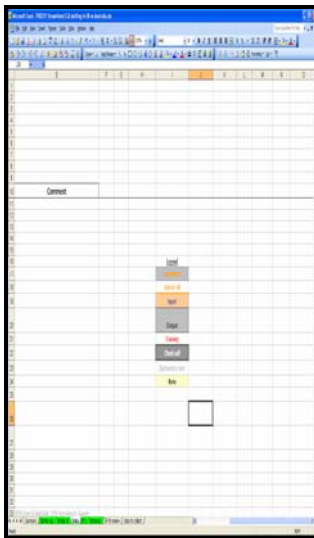
Na = Sodium Salts (mg.L^{-1})

K = Potassium Salts (mg.L^{-1})

3. Model Notation

Standard MS Excel notation has been used in the model. Please see the legend below.

Figure 3.1: Excel Legend





4. Using the Large Winery Model

4.1. Input sheet

A sample input sheet from a large winery is presented in Table 4.1. Comments clarify the detail regarding the value to be entered.

On the *input data tab*, in column B, enter values as requested in the input cells. The units are displayed in column C. In column D, example values are given for reference purposes only. Estimates are possible where exact data are not known. It is important to fill out all data for a process unit, as leaving some data out can result in output data not being calculated. For example, the frequency of a cleaning operation (i.e. daily or weekly) is crucial in the calculations. If a specific process unit is not used in a winery, the data can be left blank.

When a frequency of an operation is asked, select the frequency with the drop down box. Similarly, use the drop down box for a Yes/No question.

The column B data of the model are the only cells that should be changed. All other cells and sheets should not be altered.

Once the input data are entered, the model calculates the outputs.



Table 4.1: Large Winery Input Sheet

Input	Value	Comment
Winery Capacity	50,000	Calculated field. Winery capacity is normally determined by the total amount of fruit you intend to crush in a vintage period
Batch Size	8	crusher typical batch size
Whites Crushed	25,000	Actual tonnes of white grapes crushed
Reds Crushed	25,000	Actual tonnes of red grapes crushed
Vintage Period	45	Length of vintage period
Number of White Batches	3,125	Calculated field
Number of Red Batches	3,125	Calculated field
How often is the small (crusher and press) used?	5%	If 2 crushers are available the percentage will be used to calculate the other crusher's use. In this case the other crusher is used 95%.
Average Ferment Size	15	This value is the sum of all ferments sizes divided by the number of ferments
Crusher Information		
		<p>Push water can be used in various ways:</p> <ul style="list-style-type: none"> • If push water is used every time a batch is crushed, use 100% here. • If push water is used only at the end of several batches you need to estimate the percentage of crush batches that will result in a push through. • Use “0%” if you only have a large crusher. • If you have more than one small crusher, multiply the percentage of one crusher by the number of crushers. The model will give output data for the total number of crushers.
How often do you expect to use push water between white batches out of the small crusher?	30%	
How often do you expect to use push water between white batches out of the large crusher?	30%	Same as above
How often do you expect to use push water between red batches out of the small crusher?	30%	Same as above
How often do you expect to use push water between red batches out of the large crusher?	30%	Same as above
How often do you expect to carry out must line cleans?	Daily	If daily, the model will multiply the values related to this activity with the vintage period (in this example 45 days). Other options are hourly, weekly, and monthly. If unsure, select daily.
How often would you expect to do a small crusher clean?	Daily	As above
How often would you expect to do a large crusher clean?	Daily	As above
Do you use a stalk conveyor spray?	No	



Input	Value	Comment
How many tonnes do your fruit bins hold?	5	Fruit mass only
What percentage of your white bins would you expect to wash?	30%	The frequency is linked to vintage period. If unsure select 'Daily'.
What percentage of your red bins would you expect to wash?	30%	The frequency is linked to vintage period. If unsure select 'Daily'.
How often would you carry out a Truck Wash?	30%	Use number of truck deliveries to calculate the percentage. If every truck is washed: 100%. If 1 out of 2 trucks is washed: 50%. Average truck size of 45 tonne is used in the output data to calculate the number of truck deliveries.
White Press Information		
How often do you expect to use push water out of the small press?	50%	This percentage will depend on whether you have several press operations sequencing without intermittent washes. Use an estimated average if you are not sure. If one push through occurs in 4 press batches, the percentage will be 25%.
How often do you expect to use push water out of the large press?	50%	Same as above
How often do you expect to clean the small press after processing a batch?	50%	Same as above
How often do you expect to clean the large press after processing a batch?	50%	Same as above
How often do you expect to clean the press area?	Daily	If unsure select 'Daily'.
White Juice Racking		
How many separate tanks do you use for white wine racking in a given year?	62	Generally this is no more than the number of batches
How often do you expect to use water as a Product push-after transfer off lees?	50%	If every time, write 100%. If one in 2 times, select 50%, etc.
How often do you expect to use water as a Tank clean?	50%	Same as above
How often do you expect to use water for Line Clean/sterilisation?	50%	Same as above
How often do you expect to use water for product push post Juice centrifuge ?	50%	Same as above
Juice Centrifuge		
How many hours do you expect to run the centrifuge for Juice processing?	150	The vintage centrifuge use can be retrieved from batch records. Otherwise, estimate.
How often do you expect to clean the juice centrifuge?	Daily	If unsure select 'Daily'.
White Ferment (In Tank)		
How often do you expect to sanitise the pipe lines into the White Ferment?	100%	
How often do you expect to use water for Product push/transfer, from fermenter to storage/settling tank ?	10%	Normally after fermentation, although include transfers during fermentation if they occur. If another transfer method, such as pigging, is used, write 0%
How often do you expect to use water for Yeast transfer from yeast tank to fermenter?	30%	Include all inoculations in your estimates. If each transfer requires water push through, the value is 100%. If in situ inoculation happens, write 0%.
White Ferment (In Oak)		
How many new barrels will you expect to use in a year?	250	Value is used in Initial oak clean. Therefore include only new barrels that are washed prior to use.
How many barrels will you wash or sanitise?	260	This value is used in the post-fermentation washes, after racking of lees..



Input	Value	Comment
Red Ferment		
What percentage of the red ferment do you want to complete via rotary fermenters?	20%	The percentages will result in the respective allocation of water use and pollution for each type of fermenter. The sum of the ratios must be 100%.
What percentage of the red ferment do you want to complete via SWAPS/ Statics?	40%	
What percentage of the red ferment do you want to complete via open top tanks?	30%	
What percentage of the red ferment do you want to complete via Jet tanks?	10%	
Red Ferment – Rotary/Vinomatic		
How often do you wash the vinomatics with water after fermentation?	30%	Do you wash after each ferment (100%) or top up the emptied tank with a new ferment without wash (only washed after X ferments, and ratio is 1:X). A combination cycle of caustic – citric – water results in the same percentages for all 3 (see below).
How often do you wash the SiPrem Press after use?	30%	In case red ferments are being pressed sequentially without intermediate washes, count the number of passes before washing. The value is the ratio of wash per pass.
How often do you wash the vinomatics with Cleanskin after fermentation?	30%	As above
How often do you wash the vinomatics with caustic after fermentation?	30%	As above
How often do you wash the vinomatics with citric after fermentation?	30%	As above
In a year how many times would you expect to clean (with water) the vinomatic cellar area over a year?	25	If once per day, the vintage period can be used.
Red Ferment - SWAPS		
How often do you wash the SWAPS with water after fermentation?	30%	Same as Rotary ferments
How often do you expect to use push water to the press?	30%	Water used to push wine to press
How often do you wash the SWAPS with Cleanskin after fermentation?	30%	Same as Rotary ferments
How often do you wash the SWAPS with caustic after fermentation?	30%	Same as Rotary ferments
How often do you wash the SWAPS with citric after fermentation?	30%	Same as Rotary ferments
Red Ferment - Open fermenter		
How often do you wash the open fermenters with water after fermentation?	30%	Same as Rotary ferments
How often do you wash out the transfer tanks associated with open fermentation?	30%	
How often do you carry out line clean/sanitisation?	30%	
How often do you expect to use water for Product push-press to tank?	30%	Water used to push wine (to press
How often do you carry out a screen wash?	30%	This refers to a screen associated with the red fermenter.
In a year how many times would you expect to clean the red ferment area?	25	If once per day, the vintage period can be used.
Red Ferment - Jet tanks		
How often do you carry out a Jet tank wash prior to filling?	30%	If tank is washed each time before filling, enter 100%. Otherwise the ratio.



Input	Value	Comment
How often do you carry out a cleanskin wash prior to filling?	30%	If tank is washed each time before filling, enter 100%. Otherwise the ratio.
How often do you expect to use water for Product push- tank to press?	30%	Water used to push wine + skins to press. If no water is used then enter 0%
How often do you carry out a screen/press/lines wash?	30%	Is there a screen in jetting tank
In a year how many times would you expect to clean the red ferment area over a year?	25	If once per day, the vintage period can be used.
Red Press/Vaslin Bucher's		
How often do you expect to wash the red press?	30%	Eg. after 3 batches would result in 33%. Apply average of all ferments being pressed
How often do you expect to use push water out of the red press?	30%	Eg. after 3 batches would result in 33%. Apply average of all ferments being pressed.
How often do you expect to carry out a cleanskin wash?	30%	Eg. after 3 batches would result in 33%. Apply average of all ferments being pressed
How many times a year do you clean the red press area?	45	For example the same as the total vintage period.
Centrifuge		
How many days a year do you expect to run the centrifuge? (assume 24 hours operation)	25	If used less than 24 hrs/day, calculate the equivalent days. Thus 12 hours per day for 25 days results in 12.5 days
How often do you expect to use water for Line cleans?	Daily	Select closest frequency to hourly, daily, weekly or monthly
How often do you expect to use water for Product push at the start/end of run?	Daily	Select closest frequency to hourly, daily, weekly or monthly
How often do you expect to use water to rinse post-product?	Daily	Select closest frequency to hourly, daily, weekly or monthly
How often do you expect to use water for Caustic rinse?	Daily	Select closest frequency to hourly, daily, weekly or monthly
How often do you expect to use water for Citric rinse?	Daily	Select closest frequency to hourly, daily, weekly or monthly
Barrel Hall		
How many barrels do you expect to wash after malo-lactic fermentation in a year?	50	Refers to wash after racking off lees.
How many times in a year do you expect to push product from cellar to barrel hall with water?	10	If done for each transfer, then use number of transfers. Otherwise estimate the average.
How many times do you expect to carry out line clean/sanitisation?	200	Eg. before each transfer would result in value equalling the number of transfers.
How many barrels do you expect to store wet with acid solution?	5	Include all occasions for each barrel. Estimate number of barrels.
How often do you anticipate cleaning the barrel hall area?	5	
Blending		
How often do you use water for push though product of the blending tanks in a year?	100	
How many cold stabilisation tanks do you clean with cold water in a year?	135	A combined water-caustic-citric clean results in the same ratios. If water rinses are done separately, add them to the combined frequency. Note that other cold stabilisation methods are not included.
How many cold stabilisation tanks do you clean with caustic in a year?	135	
How many cold stabilisation tanks do you clean with citric in a year?	135	



Input	Value	Comment
Earth Filtration		
How many times during the year do you use the earth filter?	100	Include each time.
How often do you use water for End of run rinse/water wash?	30%	
How often do you wash the filter after use with Cleanskin?	30%	
RDV		
How many RDV runs do you complete in a year?	100	
How often do you replace the vacuum water?	Weekly	If unsure select 'Weekly'.
How many times a year do you expect to clean the RDV area?	50	
Reverse Osmosis		
How many days a year do you operate the RO system 24 hours a day?	25	
How many days a year do you operate the RO system for less than 24 hours?	30	If used less than 24 hrs/day, calculate the equivalent days. Thus 12 hours per day for 25 days results in 12.5 days
How many times do you expect to clean the externals surfaces and surrounding area?	15	
Cross-Flow Filtration		
How many times, in a year, do you use push water to move product to the filter?	250	Eg. after each run – count number of runs.
How many filter cleans do you do a year?	200	Eg. after each run – count number of runs
How often do you use cleaning chemicals for the Filter cleaning?	30%	Eg. at end of day operation – ratio determined by the number of chemical cleans divided by number of total washes.
Bottling		
How many days a year do you expect to run the bottle line?	120	Assume that all lines are being used.
Do you run a tirage line?	Yes	Used to calculate the water use and load, for a tirage line of X bottles per hour.
Do you run a cask line?	Yes	Used to calculate the water use and load, for a cask line of X casks per hour.
Do you recirculate vacuum pump water?	No	If unsure select 'No'.
How often do you expect to clean the bottle hall?	Daily	If unsure select daily



5. Reference data

The reference data on water use and wastewater composition can be found in the **reference data tab** of the model. While no winery is the same, the reference data provide good estimates of water use and wastewater composition. The reference data are from Ryecroft (medium/large).

The averages of all reference data for the operations in a large winery are given in Table 2.2. By entering your input data the reference data will be proportionally adjusted to the size of the specific operation.

For example, if a winery has a white crush of 50,000 tonnes instead of 25,000 tonnes, the volume of water used will be proportional to the number of crushes taking place. Also, the total COD will have doubled, etc.

Verification of the reference data can be executed independently, though the model does not yet allow inputting other reference data. A work version of the model can be created by copying the original model, and then the user can alter data as desired.

In particular, push-throughs will vary in waste water volume and composition depending on the size and length of the line.



Table 5.1: Reference Data Large Winery

Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
Large Crushers	Product push white-small crusher to press TP8&10	4.57	1157	474	10781	91	168	1341
	Product push white-large crusher to press VaslinBucher`s	3.32	1358	231	10903	87	142	5909
	Product push red-small crusher to opens/other	4.22	1128	339	10204	95	147	1891
	Product push red-large crusher to swaps,VB`s,vinos,jets	4.10	1182	250	11066	93	195	7247
	Must line cleans-large crushers	8.83	1333	49	643	251	18	5502
	Crusher cleans small crushers (RY1&2)	4.69	1008	205	5560	98	91	212
	Crusher cleans large crushers (RY3&4)	3.79	1198	661	10610	91	189	1615
	Stalk conveyor spray	3.33	913	125	2843	96	78	340
	White Bin Wash	4.19	1054	261	8591	94	145	54
	Red Bin Wash	3.96	1766	1235	20384	91	397	35
	Truck Wash	4.29	875	117	3973	89	75	167
White Press	Product push-small press (TP8&10)	5.58	1127	1248	5553	92	86	404
	Product push-large press (VB1&2)	6.66	1210	85	4131	202	56	612
	Press Clean-small press	5.00	1319	273	5013	129	199	359
	Press Clean-large press	5.57	1240	219	6008	142	128	2501
	Area Cleaning-small press	4.58	1523	332	4485	144	99	168
White Juice Racking	Product push-transfer off lees	3.97	1279	425	4520	84	263	90
	Tank clean	3.82	2557	9620	51000	79	1201	109
	Line Clean/sterilisation	10.36	2630	0	40	652	3	114
	Juice Centrifuge-product push	4.80	1169	245	16026	90	190	2448
	Juice Centrifuge Desludge	3.38	2263	86993	134000	284	2381	4800
	Juice Centrifuge clean	4.04	1085	76	553	131	17	1500
White Ferment	Line clean/sterilisation	8.04	1094	1	23	226	4	229
	Product push/transfer	3.61	953	347	33514	87	195	97



Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
	Yeast transfer	3.16	1006	331	6820	85	116	80
Red ferment-Vinomatics	Vinomatic wash	4.53	1542	530	9710	76	258	361
	Siprem press clean	3.87	1647	766	7475	101	358	183
	Product push Siprem press to tank	4.43	1069	480	7450	85	132	268
	Vinomatic cleanskin wash	7.43	1241	97	285	121	115	226
	Vinomatic caustic wash	9.33	2193	251	620	220	40	665
	Vinomatic citric wash	2.59	1830	26	1740	94	27	1135
	Area clean	5.09	1220	687	4577	98	150	305
Red ferment-SWAPS	Swap wash	4.74	2353	331	2663	253	404	496
	Product press and transfer to tank	5.32	908	37	8400	99	52	370
	Swap cleanskin wash	5.48	1095	36	115	115	109	327
	Swap caustic wash	8.70	2841	235	1500	797	638	246
	Swap citric wash	4.06	1240	25	1511	102	26	427
Red ferment-Open fermenters	Open wash	3.96	1480	897	3316	91	303	558
	Transfer tanks clean	6.61	2056	1404	6742	280	299	671
	Line clean/sanitisation	10.03	2330	6	100	577	5	300
	Product push/transfer	5.87	1361	1569	8380	116	257	507
	Screen/press wash	3.85	1860	1067	10642	101	439	476
	Area clean	3.91	946	559	5410	73	130	518
Red ferment-Jet tanks	Jet tank wash	3.68	2388	6301	12540	72	319	398
	Jet tank cleanskin wash	8.20	1317	32	0	199	83	287
	Product push/transfer	4.68	943	256	3482	91	67	812
	Screen/press/lines wash	6.54	846	18	1500	108	22	2200
	Area clean	4.92	1268	733	2740	98	168	486
Red Press	Press wash	3.93	1143	408	1968	93	182	278



Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
VB's	Product push press to tank	4.70	869	54	7810	95	53	313
	Press cleanskin wash	8.04	1485	2	493	154	147	403
	Large press area clean	5.61	756	812	3500	97	17	176
Centrifuge - Wine	Cooling water	6.47	586	42	0	88	20	3600
	Desludge	3.44	2276	4599	178750	56	1461	4800
	Line cleans	9.66	1214	10	0	293	20	466
	Product push start/end of run	4.02	1402	417	22267	94	364	3149
	Water rinse post product	3.66	2820	1669	5150	106	940	36
	Caustic rinse	7.73	4675	145	200	79	15	1107
	Citric rinse	3.55	1476	51	1730	195	20	2090
Barrel Hall	Barrel wash post malo ferment (red)	3.22	3021	18005	29365	97	941	93
	Product push cellar to barrel hall	5.18	740	29	2753	137	21	346
	Line clean/sanitisation	5.38	781	36	345	134	16	154
	Cleaning barrel hall	5.45	567	448	0	95	20	2903
	Stored barrels solution	4.04	1188	8	2650	92	63	220
	Area cleans	3.23	3050	100070	55720	90	1385	1000
Blending	Product push	4.44	1370	6608	59150	65	394	490
	Cold stabilising tank cleans	6.07	5798	514	2355	954	1062	832
	Blend tanks caustic wash	7.89	5796	1340	3876	977	543	827
	Blend tanks citric wash	2.90	1017	8	537	100	18	660
Earth Filtration	Earth filter cake drop slurry	3.69	2033	71959	157778	97	735	225
	End of run rinse/water wash	3.96	1226	1693	12523	91	193	525
	Cleanskin wash	9.63	820	375	940	152	4	660
RDV	Product push RDV	3.92	1440	761	39366	86	164	641
	Line or tank cleans	8.20	3044	4072	9424	586	74	685



Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
	vacuum re-use water	6.15	724	36	14573	67	8	3010
	Drum clean/earth removal	5.21	3197	6741	23780	311	519	1724
	Filter flush water/citric	3.18	1965	50	910	106	15	254
	Area clean	3.72	3230	62095	18480	12	84	200
Reverse Osmosis	Water In	6.10	1655	15	0	172	21	15000
	Permeate	3.16	355	20	114150	11	85	96667
	Retentate	3.26	2745	246	288000	162	633	85000
	Back Wash	4.40	1195	70	7350	87	165	622
	Apparatus cleaning	8.62	1517	20	740	392	70	1336
White Oak Fermentation	Initial oak clean (new oak)	5.13	781	9	1170	85	88	188
	Barrel wash off gross lees	3.85	2598	5642	12093	88	992	73
Cross flow filtration	Product push water/line cleans	12.52	2251	35	150	72	1186	150
	Filter cleaning cold water only	3.41	596	15	11590	72	40	846
	Filter cleaning chemical clean	12.54	40980	19	0	24	3163	390
Bottling	Bottle washing tirage line	3.30	597	345	11247	78	33	4800
	Cleaning water/citric - tirage line	3.23	172	25	1865	11	21	570
	Cleaning water/citric - cask line	2.73	520	16	25707	12	93	3417
	Cleaning water/citric - glass lines	3.07	297	47	8878	16	45	2907
	Floor wash end of day	6.30	631	273	3878	84	31	621
	Vacuum water	6.43	409	26	0	74	20	2880
	Lube water	7.21	542	83	1495	91	20	88



6. Output data

On the *output tab* data are calculated from the input data and reference data. The total water use is a sum of the individual water events (wash down, cleaning and pushing) that occur in each process. A crush operation requires cleaning, push throughs bin washes, truck washes, red/white grapes processing, which all contribute to the total wastewater load.

For example, the table below represents the wastewater output data from activities related to the crusher. The totals of a process unit represent the average waste water composition and total water volumes. In this example, crush operations contribute 12.3ML of water per annum.

Table 6.1: Crusher Output

	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/ L)	K (mg/ L)	volume (L)
Crusher Output							
Small Crusher push water whites	4.57	1,157	474	10,781	91	168	62,875
Large Crusher push water whites	3.32	1,358	231	10,903	87	142	5,262,703
Small Crusher push water reds	4.22	1,128	339	10,204	95	147	88,641
Large Crusher push water reds	4.10	1,182	250	11,066	93	195	6,454,627
Must line cleans-large crushers	8.83	1,333	49	643	251	18	247,605
Crusher cleans small crushers (RY1&2)	4.69	1,008	205	5,560	98	91	477
Crusher cleans large crushers (RY3&4)	3.79	1,198	661	10,610	91	189	69,041
Stalk conveyor spray	3.33	913	125	2,843	96	78	15,315
White Bin Wash	4.19	1,054	261	8,591	94	145	81,250
Red Bin Wash	3.96	1,766	1,235	20,384	91	397	52,286
Truck Wash	4.29	875	117	3,973	89	75	55,667
TOTAL	3.86	1,259	245	10,759	93	169	12,390,486

At the bottom of the output tab, there is a section named *Chart Data set*. This set represents the annualised data which are used for graphical representation. It also provides a summarised overview of all waste water data per Process Unit.



7. Graphs

On the *graphs tab*, each graph represents a specific waste water characteristic. For example, the pH of each operation can be compared against all other operations. This allows the user to see the overall impact of each operation. Similarly, annual water volumes are represented and the graphs to show the volume contribution of each process unit.

Combining annual water volumes with waste water data the annual waste water component load is calculated. The graphs show how much a process unit contributes to the annual COD, pH, Na, K, and EEC. Some examples are given below.

Figure 7.1 shows the relative water use from each Process Unit.

Figure 7.1: Water Use by Process Unit

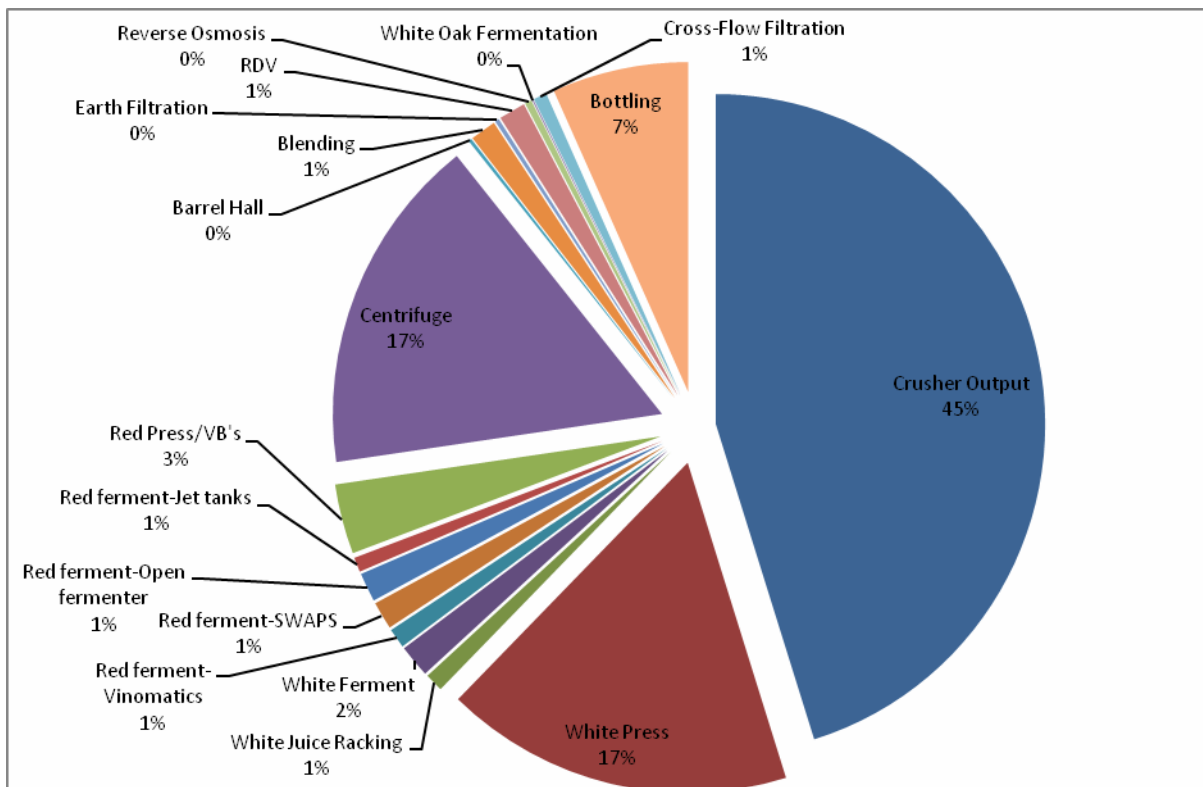


Figure 7.2 and Figure 7.3 show the COD concentration and relative COD contribution load by Process Unit.



Figure 7.2: COD concentration by Process Unit

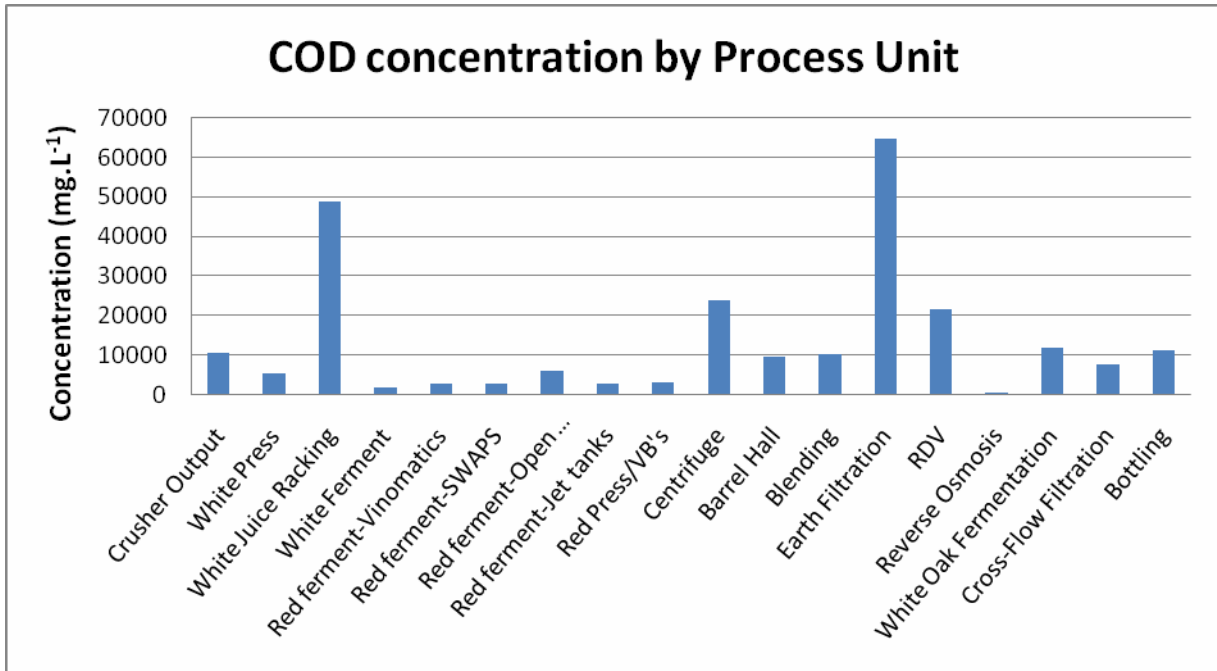
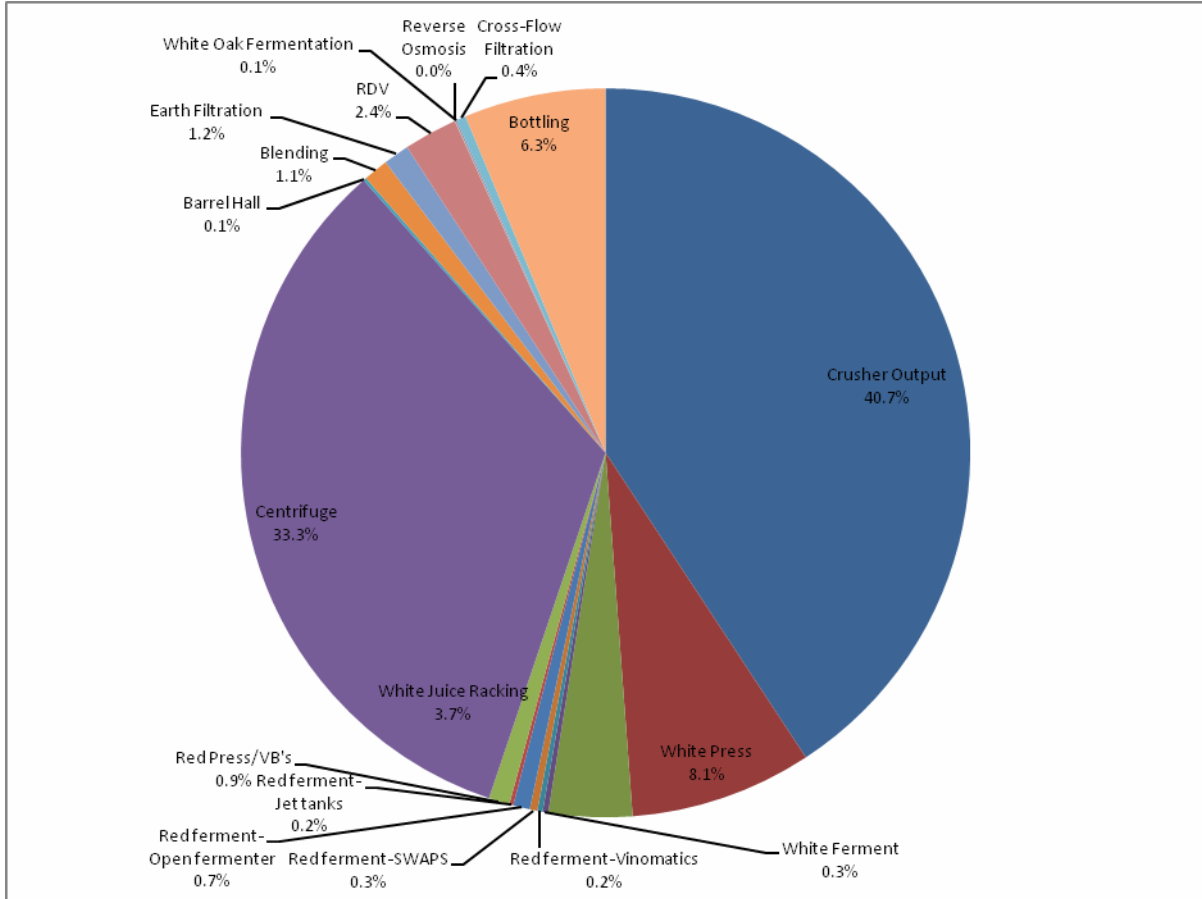


Figure 7.3: Relative COD Contribution by Process Unit







8. Using the small winery model

8.1. Input sheet

A sample input sheet from a small winery is presented in Table 8.1. Comments clarify the detail regarding the value to be entered. The same procedures for entering data as described in section 4.1 are valid.

Table 8.1: Small Winery Input Sheet

Input	Value	Comments
Winery Capacity	450	Winery capacity is normally determined by the total amount of fruit you intend to crush in a vintage period.
Batch Size	5	Your batch size may vary throughout the vintage - try to estimate as best as possible what your average batch size is likely to be.
Whites Crushed	200	Tonnes of grapes used to produce white wine. For the example winery this includes 140 tonnes of rose style wine.
Reds Crushed	250	Tonnes of grapes used to produce red wine. This includes 140 tonnes of rose style wine. If you are producing rose style wine balance the tonnes produced across the red and white categories.
Vintage Period	60	Length of vintage period.
Number of White Batches	40	This value is calculated based on the tonnes processed and the batch size.
Number of Red Batches	50	This value is calculated based on the tonnes processed and the batch size.
Crusher Information		
How often do you expect to use push water between white batches out of the crusher?	20%	The example winery only uses push water for the last batch of the day. They process 5 batches a day through the crusher so 1 out of 5 batches uses push water.
How often do you expect to use push water between red batches out of the crusher?	20%	The example winery only uses push water for the last batch of the day. They process 5 batches a day through the crusher so 1 out of 5 batches uses push water.
How often do you expect to sanitise the	5%	The example winery only sanitises after processing high quality white wine. This equates to



Input	Value	Comments
crusher and lines after a batch?		4% of the time.
During the vintage period how often would you expect to clean the crusher and crusher area?	Daily	In the example winery the crusher area was cleaned every day.
In a year how many times would you expect to do a major crusher clean?	7	In the example winery the following major cleans occurred. Prior to vintage, immediately prior to beginning white grape processing and after processing red grapes.
White Press Information		
How often do you expect to use push water out of the press?	100%	In all cases (in the example winery) water is used to push wine out of the press.
How often do you expect to clean the press after processing a batch?	30%	In the example winery 3 press cycles are completed a day. After the last cycle the press is cleaned.
How often do you expect to clean the press tray after processing a batch?	30%	In the example winery 3 press cycles are completed a day. After the last cycle the press tray is cleaned.
During the vintage period how often would you expect to clean the press area?	12	All of the white wine is processed in 13 days of operation. The press station area is cleaned once a day when the press is in operation.
White Juice Racking		
How many tanks in total are used for juice racking?	30	The example winery only has three tanks that are used for white juice racking. But each of these three tanks are used 10 times throughout the vintage.
How often do you clean and sanitise the lines after racking?	75%	In the example winery it is expected that 3/4 of the time the pumping lines will be sanitised prior to use.
White Ferment		
How often do you hot wash your tanks prior to filling?	100%	In the example winery tanks are always hot washed prior to being filled.
How often do you clean the ferment tanks with caustic prior to filling?	10%	Each tank is cleaned with caustic and citric once prior to vintage beginning. Throughout the vintage period the tanks are used on average 10 times.
How often do you expect to use push water out of the ferment tanks?	60%	About half of the time push water is not needed as other wine will be pumped into the same tank.



Input	Value	Comments
Red Ferment		
How often do you cold wash your fermentation tanks?	100%	In the example winery all of the tanks are cold washed after fermentation.
How often do you hot wash your tanks prior to filling?	100%	In the example winery all of the tanks are hot washed prior to filling for fermentation.
How many tanks do you use for your red ferments?	30	30 Tanks are used in total.
How many times do you clean these tanks with caustic and citric in a year?	1	They are all cleaned with caustic and citric prior to vintage beginning.
In a year how many times would you expect to clean the red ferment area?	60	The red fermentation area is cleaned every day during vintage in the example winery.
In a year how many times would you expect to clean the red ferment screen?	40	It is expected that the pump over screen would be cleaned about 40 times per year in the example winery.
Red Press		
How often do you expect to use push water out of the red press?	90%	Push water is used out of the red press for the majority of the time. Occasionally wine is used if pumping to a tank in a similar location.
How often do you expect to wash the press after processing a batch?	30%	In the example winery 3 press cycles are completed a day. After the last cycle the press is cleaned.
How often do you expect to clean with caustic/citric after processing a batch?	0%	The press is never cleaned with caustic and citric while processing red wine.
How often do you expect to clean the press tray after processing a batch?	100%	In the example winery the press tray is always cleaned after processing a red batch.
How many tanks will you use to rack the red wine?	30	The example winery has 10 tanks available and each uses each tank 3 times to rack the red wines.
How often do you wash the press lines with caustic and citric after a batch?	0%	In the example winery this is never done with red wines.
How many times a year do you clean the red press area?	40	The red press area is cleaned nearly once per day during the vintage period of 60 days. It is therefore assumed that the area is cleaned 40 times per year.



Input	Value	Comments
Barrel Hall		
How many barrels do you expect to wash after malo fermentation in a year?	420	The example winery generally uses about 420 barrels a year. Each barrel is used for both malo fermentation and maturation.
How many time in a year do you expect to push from oak to tank?	35	This process occurs about 35 times a year. Push water is used at the end of the day.
How often do you expect to clean the blend tank post malo fermentation?	5	The blend tank is cleaned about 5 times per year.
How many barrels do you expect to clean after maturation in a year?	420	The example winery generally uses about 420 barrels a year. Each barrel is used for both malo fermentation and maturation.
How many times will the barrel hall floor and surrounding area be cleaned in a year?	75	The barrel hall is cleaned about 3 times every two weeks.
How many barrels do you expect to store wet in a given year?	300	Stored wet between malo fermentation and maturation
Blending		
How often do you use push water out of the blending tanks in a year?	20	Push water is used about 20 times per year to transfer wine out of the blend tanks.
How often do you wash the cold stabilisation tanks with cold water in a year?	2	Two main tanks are used - they are cleaned once each per year.
How often do you wash the blend tanks with cold water in a year?	10	10 main tanks are used for blending, they are hot washed prior to filling and cold washed after emptying
How often do you wash the blend tanks with hot water in a year?	10	10 main tanks are used for blending, they are hot washed prior to filling and cold washed after emptying
How often do you clean the blend tanks with caustic/citric in a year?	10	10 main tanks are used for blending, they are washed with caustic and citric at the start of the vintage period.
How often do you clean the blend tank area in a year?	20	The area is cleaned nearly once a fortnight or about 20 times per year.
Cartridge Filtration		



Input	Value	Comments
How many filter passes do you do in a year?	9	One pass per wine style per filtration size.
Prior to a running a batch through filtration, how often do you charge the filter with citric?	100%	Normally a number of batches will be processed without changing the filter medium. A citric charge is normally only used on a new filter pad.
How often, after processing a batch, do you run an end of cycle rinse?	0%	This is never done in the example winery.
How many times a year do you clean the filtration equipment and area?	3	At the end of each major run.
Bottling		
How many separate bottling runs do you expect to complete on site this year?	5	Five bottling runs are completed per year on site.

8.2. Reference data

The reference data on water use and waste water composition can be found in the **reference data tab** of the model. While no winery is the same, the reference data provides good estimates of water use and waste water composition. The reference data are from Turkey Flat.

The averages of all reference data for the operations in a small winery are given in Table 8.2.

Table 8.2: Small Winery Reference Data

Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
Small Crusher	Crusher push water whites	3.5	842	452	11609	8	250	178
	Crusher push water reds	3.6	816	361	5465	40	185	201
	Crusher wash down & area clean	3.9	658	558	4043	30	130	832
	Crusher/Lines sanitisation	8.4	2113	211	755	293	198	664
	Major clean / End of season clean	5.6	1927	69	411	230	82	445
White Press	Product push press to tank	3.7	875	319	23396	35	209	72
	Press Cleaning	2.6	433	254	182	6	88	324
	Press Tray Cleaning	3.9	1587	2936	44381	20	610	70
White Juice Racking	Product push-transfer off lees	3.8	226	126	1360	11	30	20
	Tank clean	2.9	681	26	440	7	1	130
White Ferment	Tank hot wash	3.9	2283	3293	31265	65	1036	196
	Tank caustic clean	2.8	1218	112	4290	110	4	150
	Product push/transfer	3.5	1252	2432	89561	65	99	84
	product sample	3.1	1228	1070	92300	58	261	70
Red ferment-open steel tanks	Product push in/out of ferment	4.4	289	132	1092	20	31	97
	product sample	3.2	1575	544	279500	49	908	5
	Screen cleaning	3.6	582	473	3332	33	99	122
	Tank cleaning	3.7	1043	6061	14603	21	229	235
	Hot tank wash	4.1	1032	73	6806	15	295	101
	Caustic & citric tank wash	4.8	2196	2200	44879	118	299	279
	Area clean	4.1	386	282	1372	13	76	551
Red	Product push	4.0	1183	1838	18605	34	580	87



Unit	Water Activity	pH	EC (us/cm)	TSS (mg/L)	COD UF (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
Press	in/out							
	Press wash	3.6	1552	11350	45856	21	97	212
	Caustic & citric press clean	4.3	333	12	0	32	4	385
	Press tray clean	3.8	974	3136	25583	41	238	128
	Racking tank cleaning	3.5	2500	48888	76940	31	914	263
	Line cleans	8.4	2113	211	755	293	198	664
	Area clean	3.9	2670	246	158	12	39	405
Barrel Hall	Barrel wash post malo ferment (red)	3.5	1513	7412	7974	11	479	58
	Product push oak to tank	4.1	4613	53	3805	31	30	97
	Malo rack tank cleaning	3.5	2435	61801	78880	22	737	483
	Barrel cleaning red maturation	3.5	1653	926	12278	53	401	27
	Cleaning barrel hall?	3.5	1815	544	700	43	490	5
	Stored barrels solution	3.6	973	75	3371	5	268	11
Blending (refer barrel work as well)	Product push	4.6	803	48	29394	78	92	90
	product sample finished wine	2.9	1896	66	221500	118	763	5
	product sample lees	2.9	1060	88605	359000	115	1330	5
	Cold stabilising tank cleans	3.5	2390	17170	141500	9	599	600
	Blend tanks wash	3.5	1717	22683	106490	45	576	286
	Blend tanks caustic wash	3.8	1651	144	2480	150	40	425
	Area cleans	3.9	2670	246	158	12	39	405
Filtration by cartridge	Product push	3.6	1159	192	46140	118	102	25
	Charging water with citric?	3.2	1722	4	16400	51	335	760
	End of run rinse water	3.6	557	110	2359	64	31	175
	Area/apparatus clean	3.3	1040	151	89430	117	217	230
Bottling	Product push water	3.2	393	41	14580	32	25	308
	Wash and sanitise bottling plant	5.6	777	30	17903	98	58	282
	Water flush of bottling plant	3.2	553	9	23960	12	73	215



8.3. Output data

On the **output tab** data are calculated from the input data and reference data. The operation is made up of contributions from activities related to that operation. A crush operation requires cleaning, push throughs bin washes, truck washes, red/white grapes processing, which all contribute to the total wastewater load.

For example, the table below represents the wastewater output data from activities related to the crusher. The totals of a process unit represent the average waste water composition and total water volumes. In this example, Red Press operations contribute 37.6KL of water per annum.

Table 8.3: Output Data Small Winery Process unit

	pH	EC (us/cm)	TSS (mg/L)	COD (mg/L)	Na (mg/L)	K (mg/L)	volume (L)
Red Press							
Product push in/out	4.0	1,183	1,838	18,605	34	580	3,915
Press wash	3.6	1,552	11,350	45,856	21	97	3,184
Caustic & citric press clean	4.3	333	12	0	32	4	0
Press tray clean	3.8	974	3,136	25,583	41	238	6,410
Racking tank cleaning	3.5	2,500	48,888	76,940	31	914	7,900
Line cleans	8.4	2,113	211	755	293	198	0
Area clean	3.9	2,670	246	158	12	39	16,200
End of season clean	0.0	0	0	0	0	0	0
Total	3.8	2,096	12,062	26,409	24	318	37,609



9. Graphs

The following figures show examples of a small winery graphical output, the relative water consumption and the COD load by process unit.

Figure 9.1: Water Consumption by Process Unit for a Small Winery

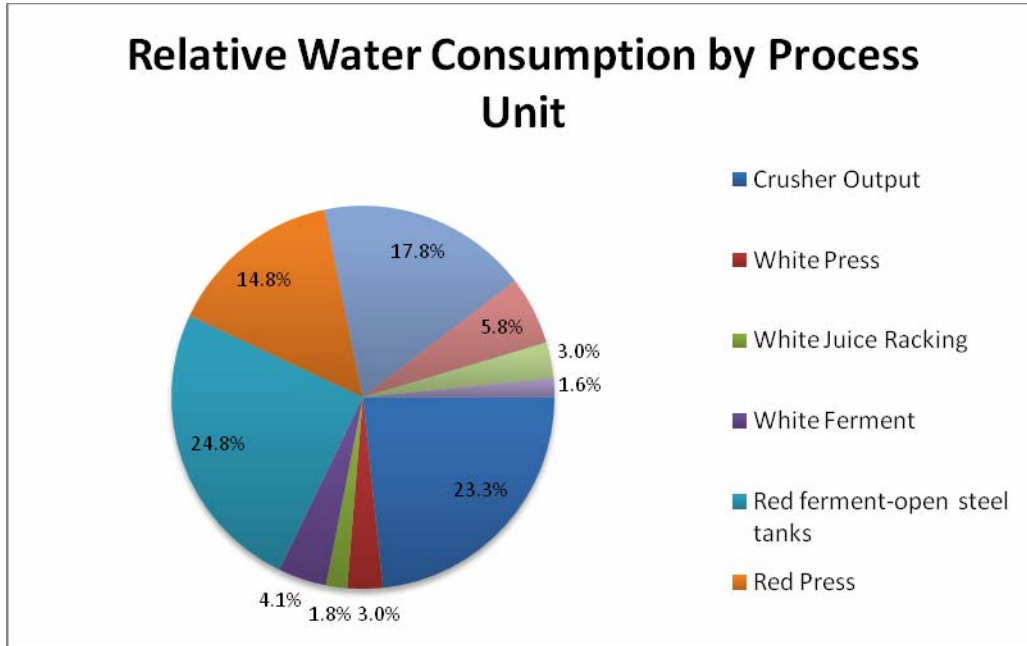
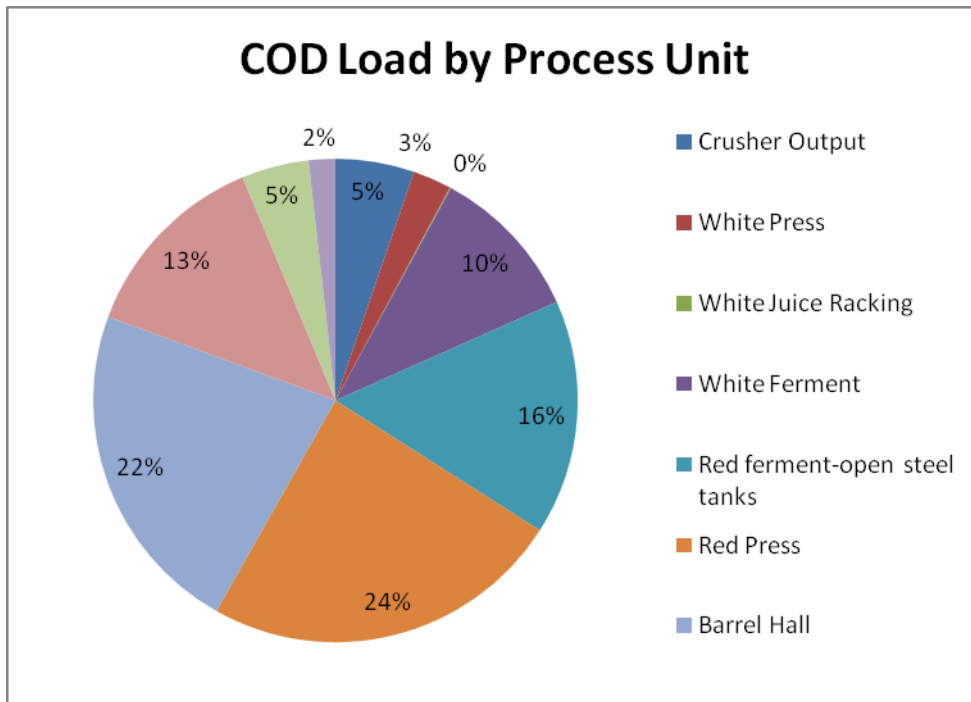


Figure 9.2: COD Load by Process Unit





10. Auditing

The model can be used for environmental improvement projects as outlined in the following examples.

Example 1:

Question: The earth filtration unit has a high specific contribution to annualised COD values. The winery wants to know whether replacing the earth filter with an RDV will lower COD, and if so, what would be the annual reduction?

Answer: First make note of the waste water contribution of the earth filter and RDV from the Chart Data set in the output sheet. Secondly, enter “0” on the input data field for “how many times during the year do you use the earth filter” Then, estimate the number of runs the RDV will be increased and enter. From the chart data set, now make note of the new RDV waste water contribution. Compare the results from the existing scenario against the new scenario.

Conclusion: the auditing process allows a winery to evaluate the change in processing process units on waste water characteristics.

Example 2:

Question: a winery is considering the purchase of bigger fermenters, replacing old small fermenters. Currently the average ferment size is 15 tonnes and the winery wishes to know the change in water volume and waste water load when the average size is increased to 20 tonnes.

Answer: First make note of the existing waste water contribution of the fermenters from the Chart Data set in the output tab. On the input tab, change the average ferment size from 15 to 20. Also update the use-ratio's in type of fermenters.