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Performance evaluation of drinking water treatment plant: A case study in Samaipata, in Bolivia

Laboratory: Centro of Auga y Sanemiento Ambiental (CASA), Universidad Mayor de San Simon, Cochabamba, Bolivia

Timeline:

- First Measurement
 - Date: 9.4.2018
 - Time : 10.30am-1pm
 - Locations : 1 sample at the Source (El Fuerte)
4 samples at the Plant
1 sample at the tap (city center)
 - Kind: Analysis in the laboratory
- Second measurement:
 - Date: 5.2.2018
 - Time: 10am-12.15am
 - Locations: 1 sample at each the source (El Fuerte La Carretera)
1 sample at the plant
1 sample at the tap (Av. Santa)
 - Kind: Analysis in the laboratory
Cl₂ residual at situ

1. Measurement 9.4.2018

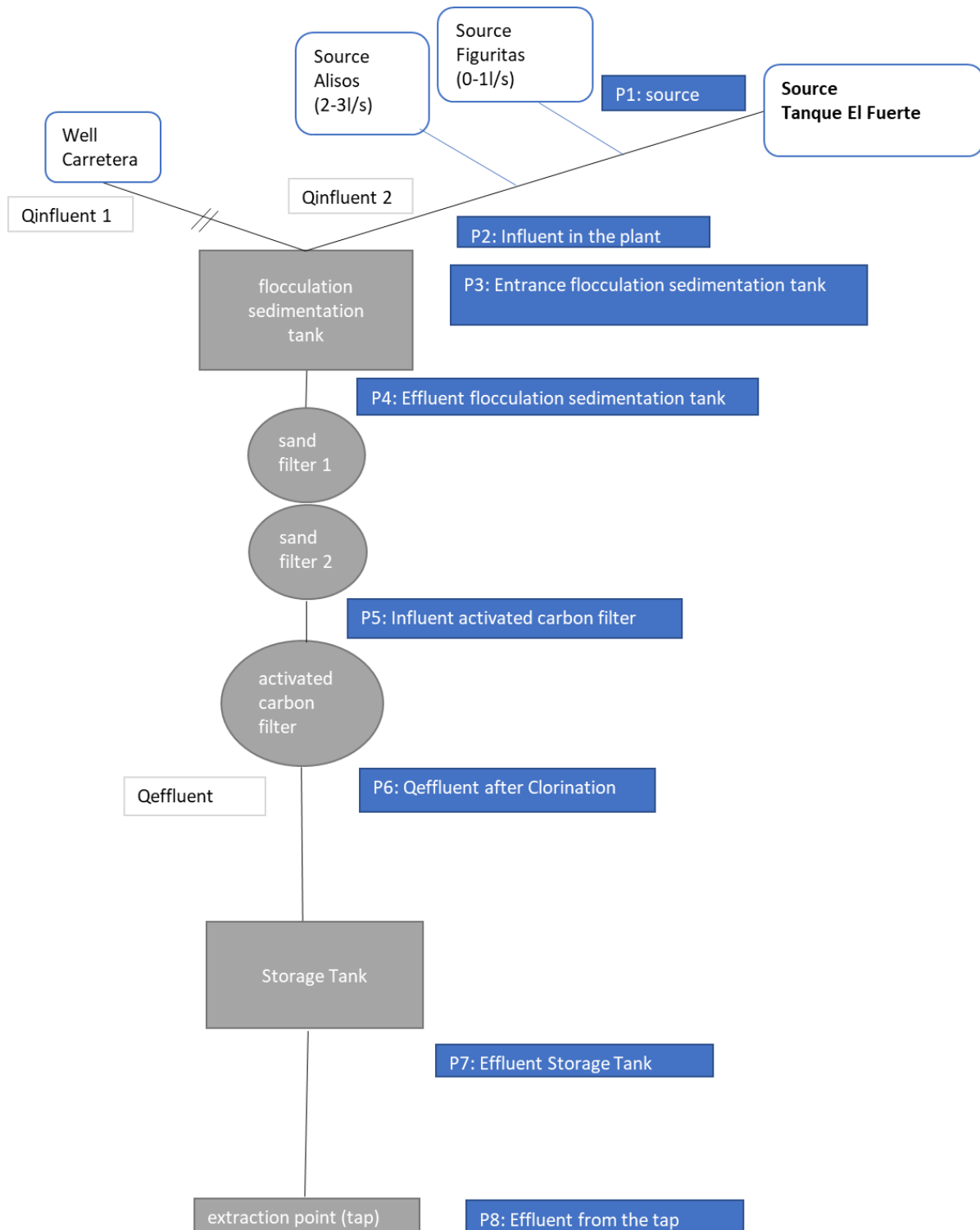


Figure 1: Points of the first measurement

Table 1: Results P1 and P2

	Sample	P1	Value	Admissible Value NB512	Unit	P2	Value	Admissible Value NB512	Unit
	Location	Source (Tanque El Fuerte) after grit				Inlet in plant			
1. Analysis	Parameter	pH	6,81	6,5-9,0	/	pH	7	6,5-9,0	/
		turbidity	7,7	5	NTU	turbidity	6,4	5	NTU
		conductivity	31,7	1500	umhos/cm	conductivity	32	1500	umhos/cm
		MO		>4 high	mg/l	MO	24,55	>4 high	mg/l
		E.coli	150	0	UFC/100 ml	E.coli	21	0	UFC/100 ml
		Total Coliforms	295	<1	UFC/100 ml	Total Coliforms	88	<1	UFC/100 ml
		Mn	0,02	0.1	mg/l	Mn	0,02	0.1	mg/l
		Fe	0,33	0.3	mg/l	Fe	0,34	0.3	mg/l

Table 2: Results P3 and P4

	Sample	P3	Value	Admissible Value NB512	Unit	P4	Value	Admissible Value NB512	Unit
	Location	Coagulation Tank (close to inlet)				Outlet Flocculation Tank			
1. Analysis	Parameter	pH	6,9	6,5-9,0	/	pH	6,91	6,5-9,0	/
		turbidity	6,2	5	NTU	turbidity	5,9	5	NTU
		conductivity	32,45	1500	umhos/cm	conductivity	32,4	1500	umhos/cm
		MO	23,64	>4 high	mg/l				

Table 3: Results P5 and P6

	Sample	P5	Value	Admissible Value NB512	Unit	P6	Value	Admissible Value NB512	Unit
	Location	Inlet Activated Carbon Filter				Outlet of the Treatment Plant			
1. Analysis	Parameter	pH	7,02	6,5-9,0	/	pH	/	6,5-9,0	/
		turbidity	6,45	5	NTU	turbidity	7,9	5	NTU
		conductivity	35,45	1500	umhos/cm	conductivity	44,5	1500	umhos/cm
						MO		>4 high	mg/l
						E.coli	0	0	UFC/100 ml
						Total coliform	0	0	UFC/100 ml
						Hardness			mg/l

Table 4: Results P7 and P8

	Sample	P7	Value	Admissible Value NB512	Unit	P8	Value	Admissible Value NB512	Unit
	Location	After the storage tank				Tap (House, Center of the City)			
1. Analysis	Parameter	Turbidity	9,2	5	NTU	pH	7,19	6,5-9,0	/
		MO	29,43	>4 high	mg/l	turbidity	6,45	5	NTU
						conductivity	41,7	1500	umhos/cm
						Hardness			mg/l

2. Measurement 5.2.2018

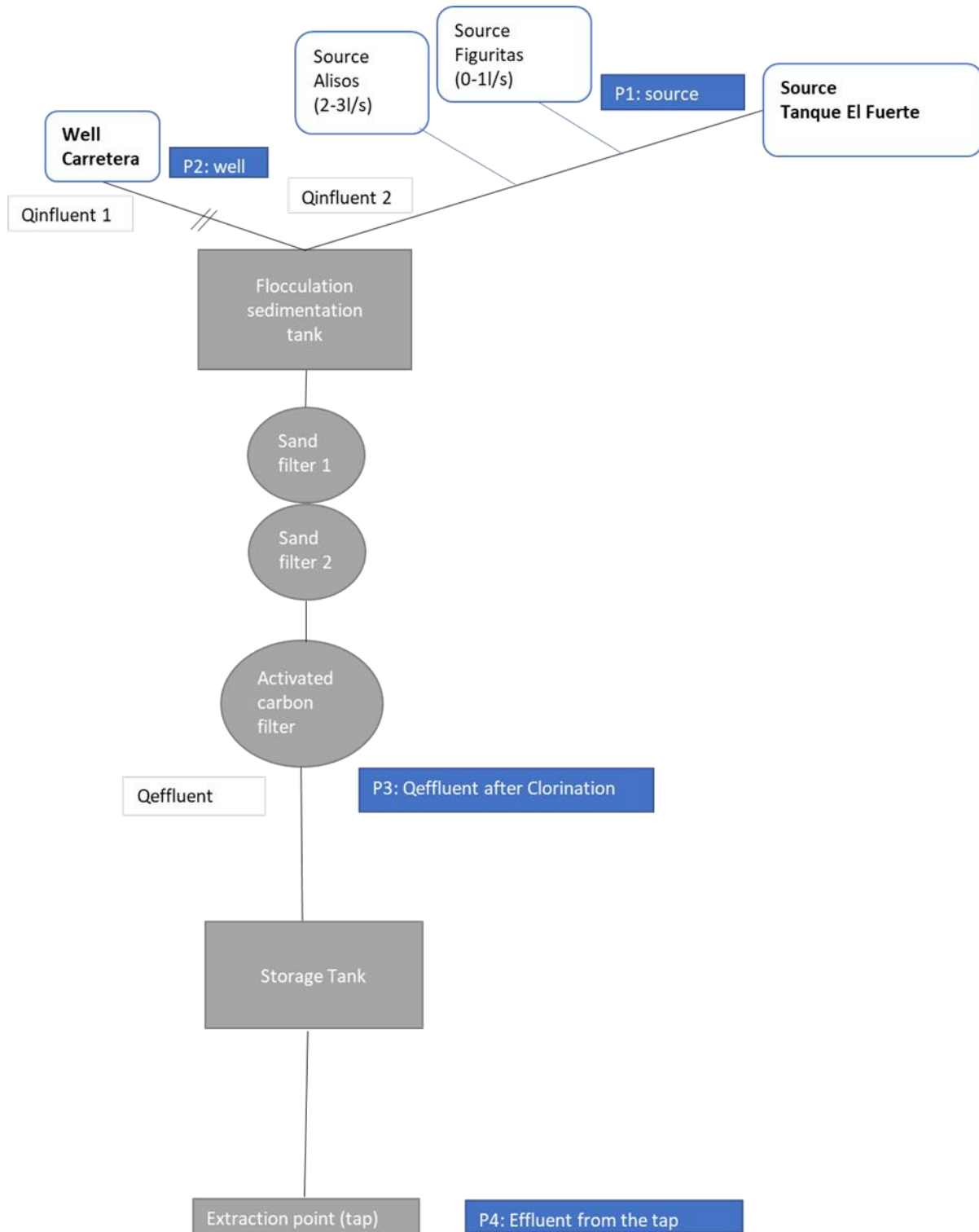


Figure 2: Points of second measurement

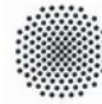


Table5: Results P1 and P2

Sample	P1	Value	Admissible Value NB512	Unit	P2	Value	Admissible Value NB512	Unit		
	Location				Source (Tanque El Fuerte) after grit				Outlet of the Treatment Plant	
2. Analysis	Parameter	pH	7.14	6,5-9,0	/	pH	6.98	6,5-9,0	/	
		Turbidity	5.5	5	NTU	turbidity	4.45	5	NTU	
		Conductivity	34.75	1500	umhos/cm	Conductivity	38.00	1500	umhos/cm	
		Total Solids	55.5	/	mgST/l	Total Solids	54.00	/	mgST/l	
		TDS	50.5	1000	mgSTD/l	TDS	53.00	1000	mgSTD/l	
		TSS	5.0	/	mgSS7l	TSS	1.0	/	mgSS7l	
		Acidity	5.85	/	mgCaCO3/l	Acidity	5.85	/	mgCaCO3/l	
		Alcalinity	17.96	370	mg/l	Alcalinity	17.96	370	mg/l	
		Calcium	2.4	/	mgCa2+/l	Calcium	2.61	/	mgCa2+/l	
		Hardness	9.5	< 500 soft	mgCaCO3/l	Chloride	0.69	250	mgCl-/L c.l	
		Chloride	0.77	250	mgCl-/L c.l	Hardness	10.00	< 500 soft	mgCaCO3/l	
		Total Iron	0.52	0.3	mgFe/L	Total Iron	0.37	0.3	mgFe/L	
		Magnesium	0.86	150	mgMg2+/L	Magnesium	0.85	150	mgMg2+/L	
		Mangan	<0.02	0.1	mgMn/L	Mangan	<0.02	0.1	mgMn/L	
		Potassium	2.13	/	mgK+/L	Potassium	2.18	/	mgK+/L	
		Sodium	4.18	200	mgNa+/L	Sodium	4.08	200	mgNa+/L	
		Sulphates	2.28	400	mgSO4/L	Sulphates	2.28	400	mgSO4/L	
		Ammonical Nitrogen	<0.1	0.5	mgN-NH3/l	Aluminium	0.05	0.1-0.2	mg/l	
						Ammonical Nitrogen	<0.1	0.5	mgN-NH3/l	
						MO	38.46	>4 high	mg/l	mg/l
				E.coli	61	0	UFC/100 ml	UFC/100 ml		
				Total Coliforms	229	<1	UFC/100 ml	UFC/100 ml		

Table 5: Results P3 and P4:

Sample	P3	Value	Admissible Value NB512	Unit	P4	Value	Admissible Value NB512	Unit	
	Location				Tap close to the plant (Av. Santa Cruz)				Pozo La Carretera
2. Analysis	Parameter	pH	6.85	6,5-9,0	/	pH	7.79	6,5-9,0	/
		turbidity	5.0	5	NTU	turbidity	4.8	5	NTU
		Conductivity	43.29	1500	umhos/cm	Conductivity	1730.5	1500	umhos/cm
		Alcalinity	13.97	370	mg/l	Total Solids	976.00	/	mgST/l
		Aluminium	0.04	0.1-0.2	mg/l	TDS	952.00	1000	mgSTD/l
						TSS	24.00	/	mgSS7l
						Acidity	22.23	/	mgCaCO3/l
						Alcalinity	658.68	370	mg/l
						Calcium	20.4	/	mgCa2+/l
						Carbonate	<0.01	/	mgCaCO3/l
						Chloride	167.45	250	mgCl-/L c.l
						Hardness	120	>500 hard	mgCaCO3/l
						Total Iron	<0.02	0.3	mgFe/l
						Ferrous Iron	0.24	/	mgFe2+/l
						Magnesium	17.08	150	mgMg2+/L
						Mangan	0.02	0.1	mgMn/L
						Potassium	5.67	/	mgK+/L
						Sodium	514.6	200	mgNa+/L
						Sulphates	1.14	400	mgSO4/L
						Ammonical Nitrogen	0.54	0.5	mgN-NH3/l
						MO	24.75	>4 high	mg/l
						E.coli	0	0	UFC/100 ml
						Total Coliforms	238	<1	UFC/100 ml

Cl₂ residual measurement

Date: 5.2.2018

Time: 10am-12.15am

Table 6: Results of the Cl₂ residual measurement

Location	Point of measurement	Measured Cl ₂ residual (Kit Vulacano) [ppm]
Effluent of plant	Tap	<0.3
After the storage tank	Tap	<0.5
End of distribution system, tap	Tap	0-<0.2

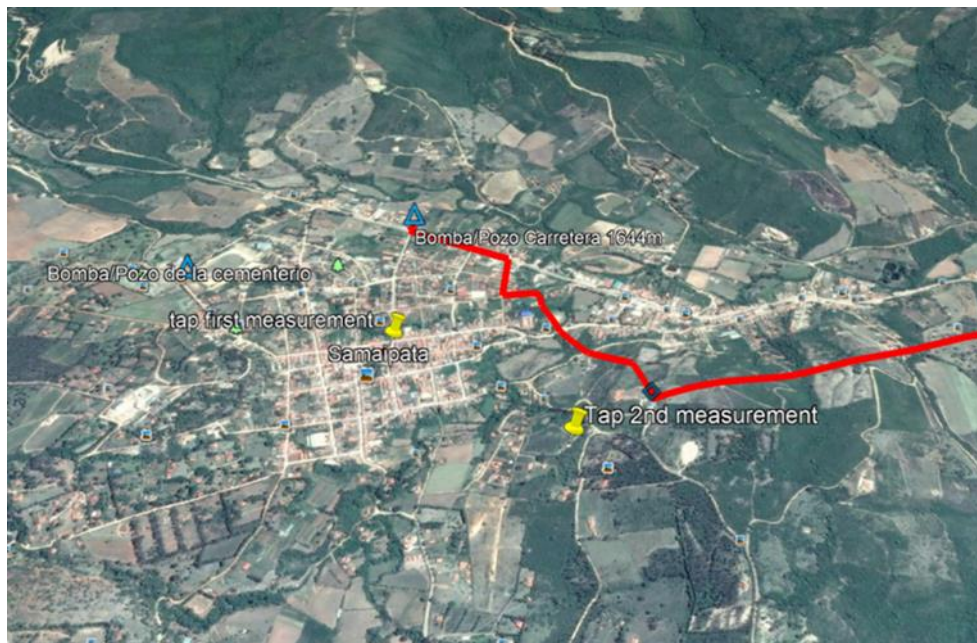


Figure 3: Locations of the tap from the first and second measurement in Samaipata