IWAS Brazil ÁGUA-DF

Final Workshop June 4-6, 2013

Universidade de Brasília 50 1962 2012

Options in Water Treatment For Paranoá Lake

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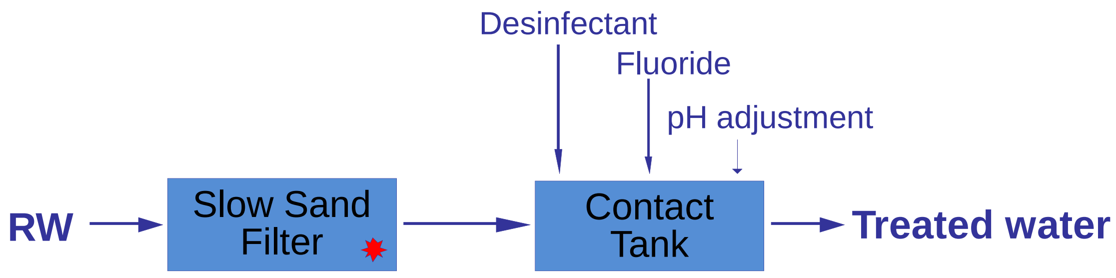
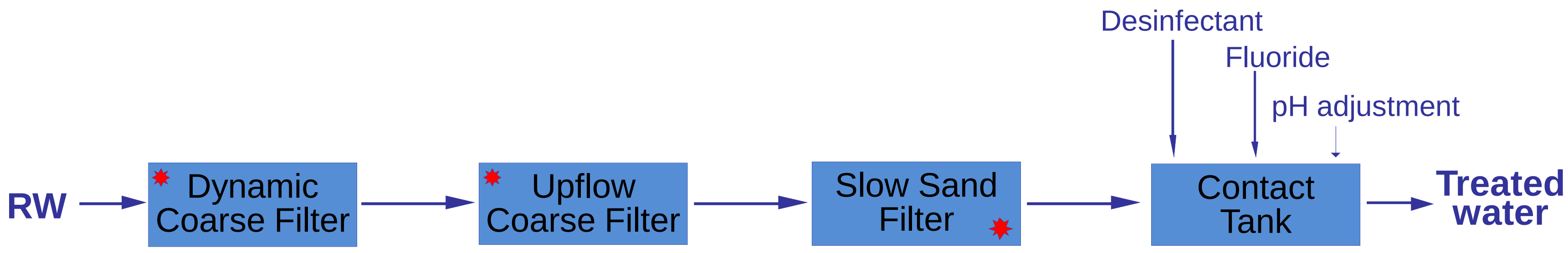
Processes Trains Without Addition of Coagulant

1 – Slow sand filtration



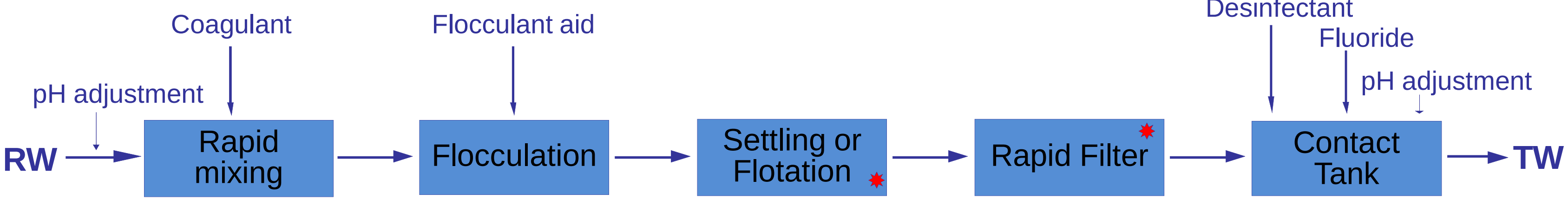
2 – Multi stage filtration



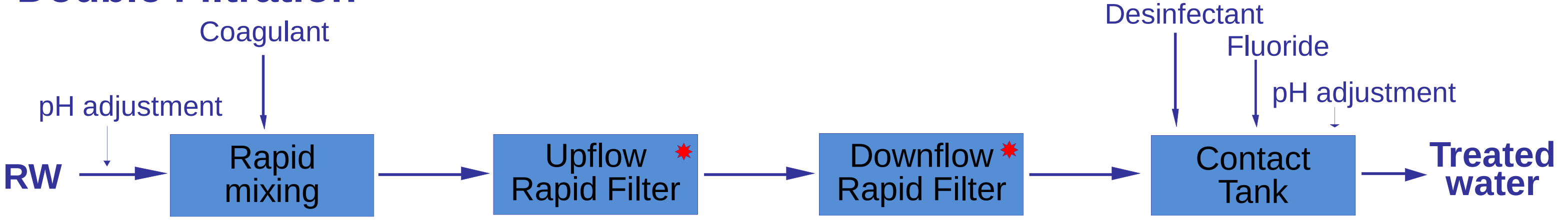
✸ Processes that generate residue

Processes Trains With Addition of Coagulant

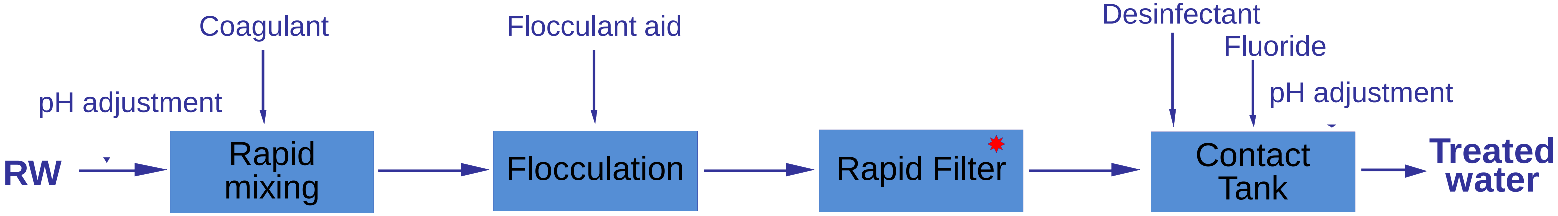
1 – Conventional Treatment



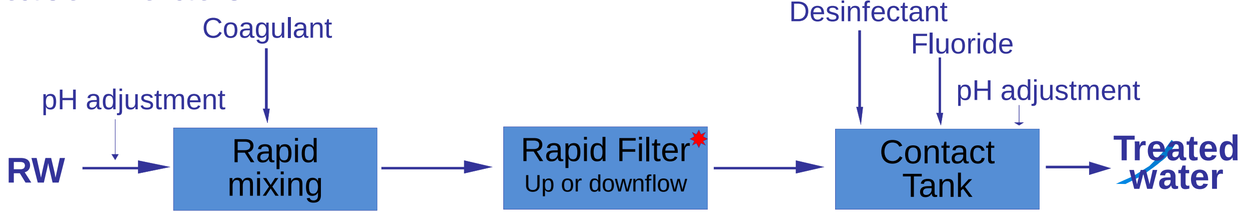
2 – Double Filtration



3 – Direct Filtration



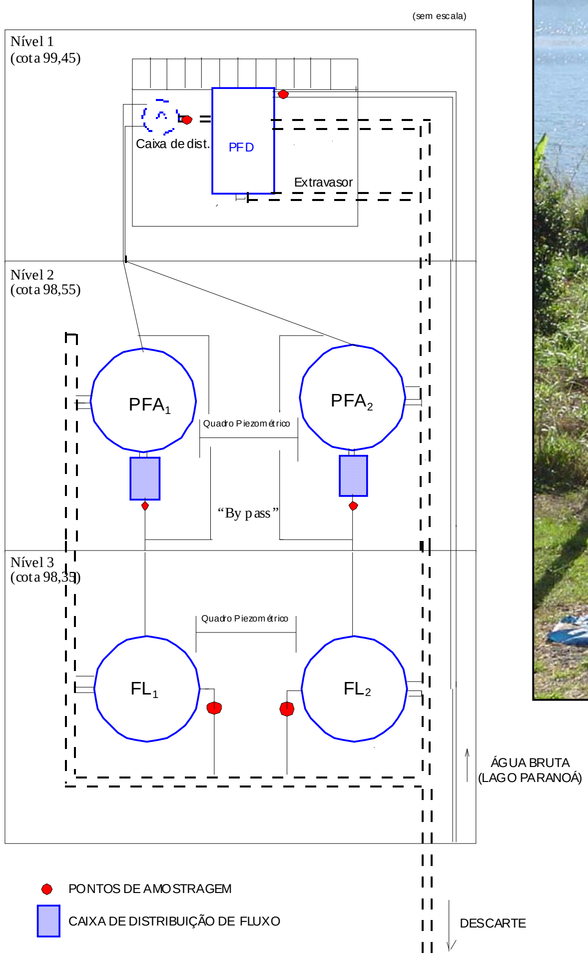
4 – Contact Filtration

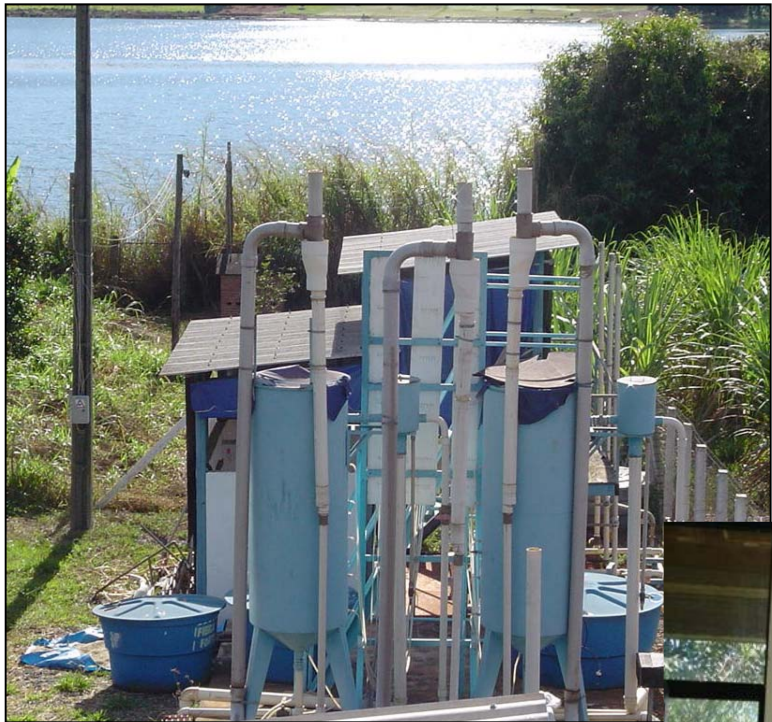


Slow sand filtration experiments

Author(s)/Year	Main target	Scale	Remarks	Results
Sá, 2002	Removal of algae and cyanobacteria	Pilot	Water spiked with *Microcysts aeruginosa* and microcistins. Comparison of traditional SSF with SSF with GAC layer	Under optimized conditions and after the ripening period: - Tubidity < 0.5 NTU - Very high removal of *E.Coli* with a significant number of samples with no EC detected - 2 log to 3 log removal of *Cryptosporidium* oocystis - Can cope with up to 10^5cells/mL of cyanobacteria without problems of cyonotoxins in the treated water - Chlorophyll-a < 1 µg/L
Arantes, 2004	Removal of algae and cyanobacteria	Pilot	Paranoá water spiked with *Cylindrospermopsis raciiborskii* and saxitoxins.	
Peralta, 2005	Removal of *Cryptosporidium oocistys*	Pilot	Paranoá water spiked with *Clostridium perfringens* and *Cryptosporidium oocistys*.	
Sá, 2006	Removal of algae and cyanobacteria	Pilot	Water spiked with *Microcysts aeruginosa* and microcystins. Optimization of filtration rate, bed depth and media size	
Teixeira, on going	Removal of picoplanktonic algae	Pilot	Variation of filtration rate	- Tubidity < 0.2 NTU - *E.Coli* not detected - Chlorophyll-a < 0.3 µg/L

Multi Stage Filtration Experiments





Multi Stage Filtration Experiments

Author(s)/Year	Main target	Scale	Remarks	Results
Mello, 1998	Removal of algae and cyanobacteria	Pilot	Variation of filtration rate on dynamic and upflow coarse filters	Under optimized conditions and after the ripening period: - Tubidity < 0.5 NTU - Very high removal of *E.Coli* with a significant number of samples with no EC detected - 3 log to 4 log removal of *Cryptosporidium* oocystis - Can cope with up to 10^5cells/mL of cyanobacteria without problems of cyonotoxins in the treated water - Minimize the risk of cell breakthrough when RW contains 10^6cells/mL of cyanobacteria or more - Chlorophyll-a < 1 µg/L
Souza Jr., 1999	Removal of algae and cyanobacteria	Pilot	Variation of filter media size of upflow coarse filters	
Carvalho, 2000	Removal of algae and cyanobacteria	Pilot	Use of coagulant before upflow corse filter	
Melo, 2006	Removal of algae and cyanobacteria	Pilot	Paranoá water spiked with *Cylindrospermopsis raciiborskii* and saxitoxins.	
Habe, 2005	Removal of *Cryptosporidium oocistys*	Pilot	Paranoá water spiked with *Cryptosporidium oocistys*.	

Contact, Direct an Double Filtration Experiments

Contact, Direct an Double Filtration Experiments

Author(s)/Year	Main target	Scale	Remarks	Train	Results
Cezar, 2000	Removal of algae and cyanobacteria	Pilot	Comparison of upflow and downflow rapid filtration preceded (or not) by upflow corse filtration	CF and DDF	Under optimized coagulation conditions (pH and coagulant dose): - Tubidity < 0.5 NTU - Chlorophyll-a ~ 1 µg/L - 3 log to 4 log removal of *Cryptosporidium* oocystis during steady state filtration. In early stages of the filtration run (first 30 min) the efficiency is about o.5 log lower - Filtration rates up to 450 m/d could be used in DDF without compromise the water quality
Melo, 2003	Removal of algae and cyanobacteria	Pilot	Upflow coarse filter followed by downflow sand filter. Optimization of filtration rate and upflow coarse filter media size.	DDF	
Braga, 2005	Removal of algae	Pilot	Upflow coarse filter followed by downflow sand filter. Optimization of filtration rate and sand media size. Comparison of alum with PAC	DDF	
Paiva, 2006	Removal of *Cryptosporidium oocistys*	Pilot	Paranoá water spiked with *Cryptosporidium oocistys*.	DFCF	
Nascimento, 2009	Removal of *Cryptosporidium oocistys*	Pilot	Paranoá water spiked with *Cryptosporidium oocistys*.	UFCF	
Schleicher, 2011	Removal of algae and cyanobacteria	Pilot	Comparison of alum with chitosan as coagulant. Water spiked with with *Microcysts aeruginosa*	UFCF	

Settling and Dissolved Air Flotation Experiments

Author(s)/Year	Main target	Scale	Remarks	Train	Results
Bezerra, 2005	Removal of cyanobacteria and cyanotoxins release from sludge	Bench	Paranoá water spiked with *Cylindrospermopsis raciiborskii*. Comparison of settling and DAF	SET and DAF	Under optimized coagulation conditions (pH and coagulant dose) - DAF was more efficient (~ 90%) than sedimentation (~ 80%) and less influenced by flotation rate variation - Saxitoxins ere realized from the sludge after 4 to 10 days of storage and underwent transformation, which was influenced by coagulation pH but not influenced by the coagulant
Ermel, 2009	Cyanotoxins release from settled sludge	Bench	Paranoá water spiked with *Cylindrospermopsis raciiborskii* and *Microcysts aeruginosa*. Comparison of alum with ferric chloride	SET	

Settling and Dissolved Air Flotation Experiments

Author(s)/Year	Main target	Scale	Remarks	Train	Results
Araújo and Oliveira, 2009	Removal of algae	Bench	Variation of surface flow rate, recycle ratio, and flocculation time	DAF	Under optimized coagulation conditions (pH and coagulant dose): - Tubidity < 1 NTU with flotation rates up to 360m/d - Chlorophyll-a ~ 1 µg/L - Recycle of 10% and flocculation times of 7 minutes was shown to be the best operational condition.
Pinto e Dantas Filho, 2010	Removal of algae	Pilot	Variation of surface flow rate, recycle ratio, and flocculation time	DAF	

Settling and Dissolved Air Flotation Experiments

Author(s)/Year	Main target	Scale	Remarks	Train	Results
Capelete, 2011	Removal of algae and cyanobacteria. THM formation potencial	Bench	Paranoá water spiked with *Microcysts aeruginosa*. Comparison of alum with chitosan as coagulant	SET	Under optimized coagulation conditions (pH and coagulant dose) - Tubidity ~ 0.3 NTU, independently of RW quality (spiked or not with *M. aeruginosa*) when chitosan was the coagulant - Tubidity ~ 0.4 NTU and ~ 0.8 NTU, respectively, for Paranoá water and spiked water, when alum was the coagulant - UV254 removal ~ 40% - NO THM formation observed

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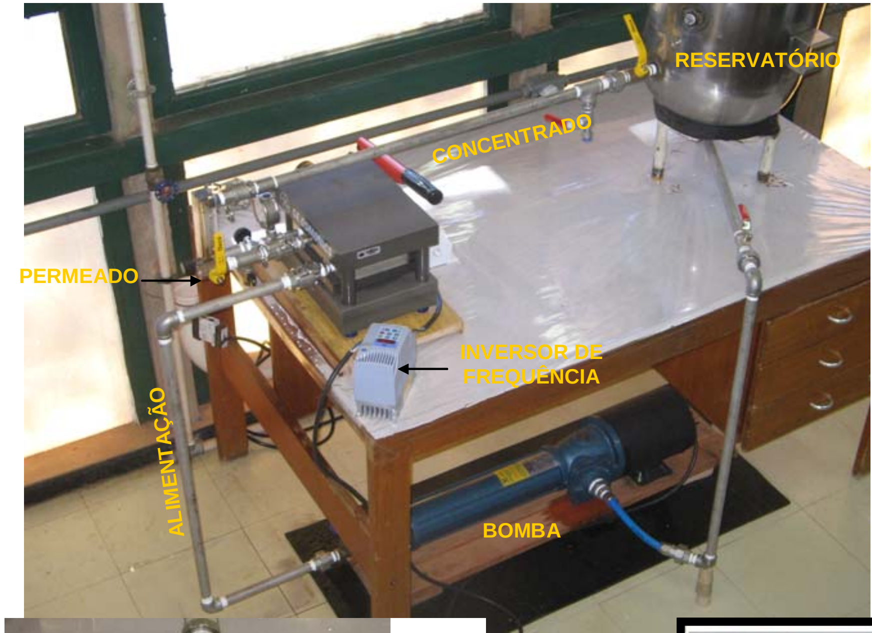
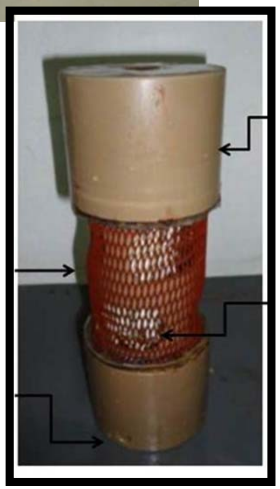
Membrane Technology Experiments





Membrane Technology Experiments

Author(s)/Year	Main target	Scale	Remarks	Type	Results
Tsuzuky e Corrêa, 2012	Removal of algae and NOM	Continuous flow bench	Influence of flocculation time. Comparison of alum with chitosan as coagulant	HSMF	Flocculation time of 30 minutes led to lower permeability decay over 4 hours run without cleaning. At optimum flocculation conditions:
Schleicher, on going	Removal of bisphenol A, estrone, estradiol and ethinylestradiol	Continuous flow bench	Influence of pH and Paranoá lake water. Two nanofiltration membrane.	NF	Preliminary results shows removal over 90% and negligible influence of the Paranoá lake water whem compared to DW matrix

Final Remarks

Paranoá lake water can be treated by a variety of processes due to its “good” quality regarding turbidity, algal density, and organic matter.

Nevertheless, multiple barriers treatments should be used considering the risks involved due to the fact that Paranoá lake water receives the effluent of WWTP and is not a protected reservoir.

Emerging substances and emerging pathogens is a mater of concern worldwide and also in DF, therefore future research has to focus in this issues both optimizing “traditional” processes as well advanced processes