

平成26年度(第一期)水道分野
海外水ビジネス官民連携型
案件発掘形成事業
報告書

平成 27 年 3 月
株式会社神鋼環境ソリューション

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1.調査概要

1.1 ホーチミン市概要

ホーチミン市はベトナム社会主義共和国南部に位置する都市であり、国内最大の人口を有している。(図-1.1, 表-1.1) 市場経済に則って国家管理のもとで人民を豊かにし、文化的で強い国家を建設することを目標とするドイモイ政策による市場経済システム導入以降、同市の経済活動は活発化し、ベトナム国民総生産の 20% 余りを占めるベトナム経済の要所、同国最大の都市となっている。



図-1.1 ホーチミン市 位置

表-1.1 ホーチミン市概要

地理	
地方	ベトナム南部
面積	2,095km ²
統計	
人口	7,818,200 人 (2013 年)
人口密度	3,731 人/km ²

出典：General Statistics Office HP より

1.2 サイゴン水道公社 (SAWACO) 概要

サイゴン水道公社は、フランス統治時代の 1880 年にフランス軍によってベトナム国で最初に創設された水道事業体である。現在、8 社の管理公社、3 社の浄水場管理公社を有している。管理公社のうち 6 社は民営化しており、その株式を海外企業が購入することは制度上可能となっている。

市内の浄水場は 5 か所あり、最大は Dong Nai 川を水源とする Thu Duc 浄水場の 75 万 5 千 m³/日で、2 番目は Saigon 川を水源とする Tan Hiep 浄水場の 30 万 m³/日である。浄水量に占める水源種別の比率は表流水（河川）からの取水が 93.9%、伏流水（地下水）からの取水が 6.1%となっている。ホーチミン市は、ベトナム政府の掲げる「都市水道開発指針 2025（2009 年 11 月首相決定書 1929 号）」に基づき、以下の開発目標（表-1.2）を立てている。

表-1.2 開発目標

項目	2015 年	2025 年
施設能力 (m ³ /日)	2,4000,000	3,4000,000
管網の新設 (km)	1,393	1,015
管網の更新 (km)	527	700
無収水率 (%)	32	25

出典：「平成 22 年度水道産業国際展開推進調査・報告書」

1.3 調査背景

ホーチミン市は、近年の経済発展に伴い、生活雑排水による河川の汚染が深刻化している。中でも、高い濃度のアンモニア態窒素が確認（表-1.3）されている Saigon 川を水源とする Tan Hiep 浄水場（浄水能力 30 万 m³/日）にとっては、その高い塩素注入率から住民の健康にも直結する重大な課題となっている。

表-1.3 ホーチミン市 河川水質

濁度 (NTU)	アンモニア態窒素 (mg/L)	マンガン (mg/L)
33	0.76	0.0097

出典：2012 年 11 月水質測定データ（サイゴン水道公社提供）

この対応策として、サイゴン水道公社は、Tan Hiep 浄水場の新たな水道水源として、生活雑排水の影響を受けていない Dau Tieng 湖からの長距離導水（図-1.2）を計画しているところである。しかし、この遠距離導水事業には莫大な費用（弊社試算で 400Million～800MillionUS\$）が必要となることから、サイゴン水道公社は、遠距離導水以外の解決策についても検討している。

創設	1880年		
行政人口	6,106,000人		
給水区域内人口	6,058,000人		
給水人口	4,727,000人		
普及率	78%		
給水戸数	615,000戸		
無収水率	40%		
料金収入(年間)	1,800,000,000,000VND		約90億円
給水時間	24時間		
水道料金	家庭用	2,700 VND/m ³	14 円/m ³
	公共用	6,000 VND/m ³	30 円/m ³
	工業用	4,500 VND/m ³	23 円/m ³
	商業用	8,000 VND/m ³	40 円/m ³
給水管延長	4,156km		
浄水能力 5つの浄水場	1,550,000 m ³ /日	Thu Duc浄水場	755,000 m ³ /日
		Tan Hiep浄水場	300,000 m ³ /日
		Tan Binh浄水場	70,000 m ³ /日
		その他	425,000 m ³ /日

表-1.4 サイゴン水道公社概要



図-1.2 長距離導水計画平面図

このような状況の中、サイゴン水道公社は、ハイフォン市水道公社が 2013 年ビンバオ浄水場（5,000m³/日）に導入した高度浄水処理施設「上向流式生物接触ろ過池」（以下、U-BCF）に強い関心を示し、2013 年 6 月、北九州市上下水道局に対して、U-BCF に関する技術協力

を文書で要請した。

これを受けた北九州市上下水道局は、2013年5月30日付でハイフォン市水道公社と締結した「ベトナム国における U-BCF 普及に向けた相互協力協定」(添付資料-1)に基づき、ハイフォン市水道公社と共にホーチミン市を訪問し、現地水源の状況を把握するとともに、北九州市の U-BCF 技術について概略説明した。説明を受けたサイゴン水道公社は、U-BCF の本格導入に向けた検討を進めていきたい意向を強く示し、その最初の取り組みとして、Tan Hiep (タンヒエップ) 浄水場 (30 万 m³/日) に U-BCF のパイロットプラントを設置して 1 年間の実証実験を行い、現地水源水質に対する U-BCF の有効性についての技術的な検証を行うことを北九州市上下水道局及びハイフォン市水道公社に要望した。

この U-BCF 技術は、北九州市が国内特許(プロセス)を有する技術であることに加え、(株)神鋼環境ソリューションが U-BCF の中核部品に係る特許を取得していることから、両者協力のもと今回の事業に応募し、厚生労働省はこれを採択した。採択を受けた北九州市上下水道局は、今回の実証実験を成功裏に完了させるために、同公社のトップを日本に招聘し、お互いの協力内容を覚書に定め、3 者間(北九州市上下水道局、サイゴン水道公社、ハイフォン市水道公社)で締結した。(図-1.3)



図-1.3 覚書締結 (北九州市)

1.4 U-BCF 概要

上向流式生物接触ろ過池 (U-BCF) は、高度浄水処理の一つに分類され、北九州市上下水道局が約 11 年間の研究を重ねて開発した技術である。(図-1.4)

この U-BCF 技術に関し、北九州市は「プロセス特許」を取得し、(株)神鋼環境ソリューションが中核部品に係る「ハード特許」を取得している。北九州市上下水道局は、U-BCF を市内 2 つの基幹浄水場に導入し、国内の他都市においては、現在 9 つの浄水場に導入されている。



図-1.4 北九州市の U-BCF

U-BCF は、生物処理を可能にするろ過材として粒状活性炭を用い、自然の川底の小石などに付着した微生物が、汚濁物質を取り込み分解する作用を、人工の装置内でより効果的に再現している。この粒状活性炭は、粒径が 0.4~0.5mm と小さく、表面が凸凹(多孔質)で小石などよりはるかに微生物が生息できる形状である。さらに、これを槽内に充填し下から上に通水(上向流)することで、活性炭を流動させ、槽全体を有効に活用し、生物接触効率の向上を実現している。この微生物による自然浄化作用によって、原水中の有機物を 30~40%分解するとともに、多量に塩素を消費するアンモニア態窒素や溶

存マンガンを 60～90%除去することで、塩素の注入量を削減することができる。(図-1.5)

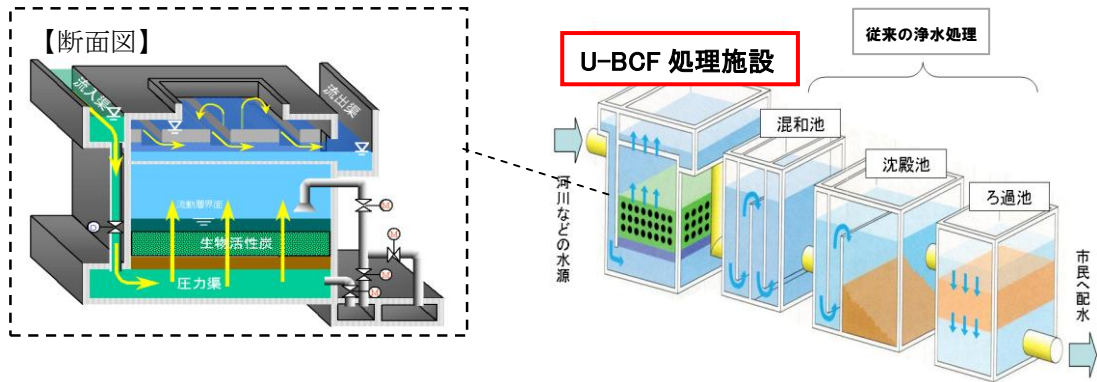


図-1.5 U-BCF 概略図

1.5 前年度調査概要

Saigon 川における U-BCF の原水水質改善効果を確認することを目的とし、パイロットプラントを使用した実証実験を主として前年度から調査を開始した。

前年度実証実験の概要を以下に示す。

表-1.5 パイロットプラント試験結果（2014 年 2 月度、平均値）

水質項目	原水水質	U-BCF 処理水	
		水質	除去率
水温 (℃)	28.6	25.3	—
pH (—)	6.23	6.51	—
濁度 (NTU)	20.7	17.1	17%
E260 (—)	0.434	0.321	26%
アンモニア態窒素 (mg/L)	0.078	0.052	33%
溶存マンガン (mg/L)	0.020	0.012	40%
溶存鉄 (mg/L)	0.21	0.17	19%

*E260（紫外線吸光度）は、水中に含まれる有機物の量を表す手法。波長 260nm の紫外線を吸収する度合いであり、E260 が大きくなると水中の有機物の量が多くなる。

生物処理機能は、アンモニア態窒素、溶存マンガンが低減していることから発現していることは確認できた。

しかしながら U-BCF の原水水質改善効果を定量的に判断するためには、原水水質が悪化する雨期（5 月～11 月）でも確認することが必要不可欠であり、今年度についても継続して調査を行う事となった。

1.6 調査体制

今回の調査は、以下の4者による連携体制で実施した。

① (株)神鋼環境ソリューション・・・調査主体

- // 中核機械部品の提供
- // 技術支援
- // 現地法人を通じた運転維持管理

② 北九州市上下水道局、一般財団法人 北九州上下水道協会・・・技術的アドバイザー

- // 官として、サイゴン水道公社とのコミュニケーション
- // 水質分析支援

③ ハイフォン市水道公社・・・サイゴン水道公社との連絡調整

- // 運転維持管理支援
- // 水質分析支援

1.7 調査工程

現地調査は計3回実施した。各現地調査の概要を以下に示す。

1 回目現地調査：処理状況改善のため、簡易ブロワーおよび遮光カーテンの設置
(2014年5月)

2 回目現地調査：多段式トレイ設置、圧縮空気を使用したDO改善策の実施
(2014年9月)(併せて中間報告会を開催)

3 回目現地調査：活性炭洗浄、パイロットプラント改造
(2014年12月)

3月にはこれまでの実証実験のまとめとして最終評価会を開催し、実証実験の実績・評価を行い、今後のスケジュールについて協議を行った。

		2014年								2015年		
		5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月
日本側	神鋼環境ソリューション	現地調査				現地調査 中間報告			現地調査			最終評価会
	北九州市上下水道局	現地調査				現地調査 中間報告			現地調査			最終評価会
ベトナム側	サイゴン水道公社	実証実験・運転維持管理										→
	ハイフォン水道公社	現地調査				現地調査 中間報告			現地調査			最終評価会
		↑ 簡易ブロワー・遮光カーテン設置				↑ DO改善策実施 (多段式トレイ、圧縮空気)				↑ 活性炭洗浄 パイロットプラント改造		↑ 報告書提出

図-1.6 調査工程スケジュール

2. 調査および実証実験

2.1 実証実験フロー

図-2.1 に本実証実験フローを示す。(添付資料ー 2 参照)

Saigon 川から取水した原水は、実証実験装置の原水分配槽にて一旦受け、流量計を経て各 U-BCF に上向流で所定の流量で通水される。

洗浄は、原水と空気による洗浄を 2 日に 1 回の頻度で手動で行った。(但し、U-BCF カラムへの藻の発生が多量に認められてからは、1 日に 1 回の頻度とした。)

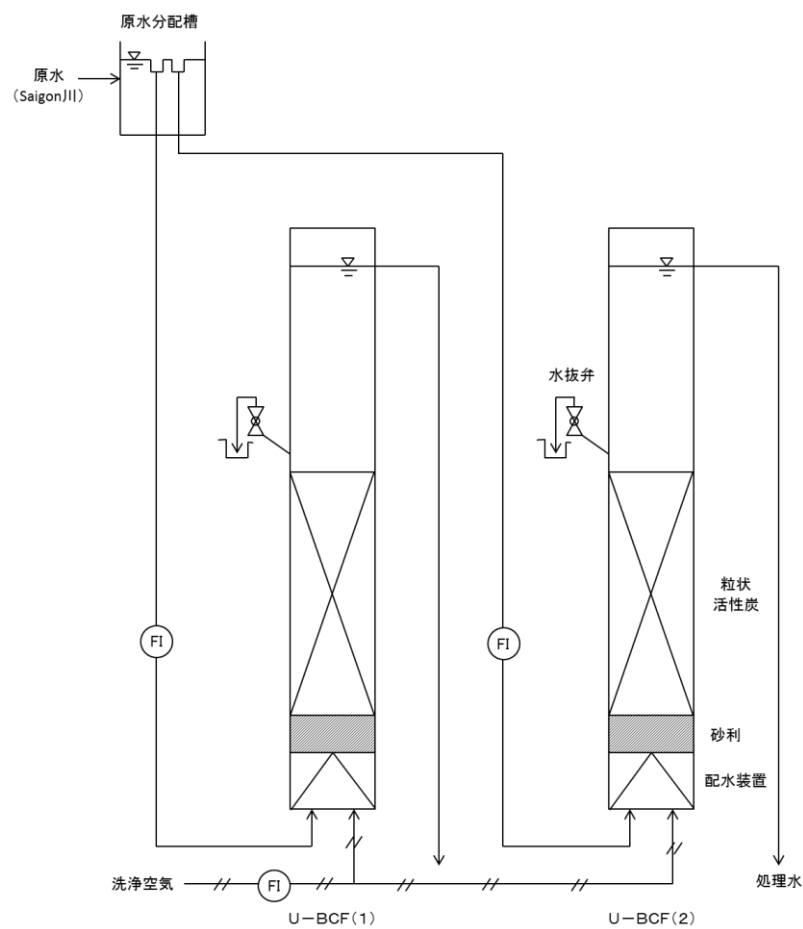


図-2.1 実験実証フロー

U-BCF(1), (2)の実験条件を表-2.1 に示す。

表-2.1 U-BCF 実験条件

	U-BCF (1)	U-BCF (2)
線速度 (LV)	15 m/h	15 m/h
空間速度 (SV)	10 l/h	15 l/h
充填層高	1.5 m	1.0 m
滞留時間 (l/SV)	6.0 min	4.2 min

2.2 実証実験装置諸元

実証実験装置の仕様を以下に示す。

①基本仕様	型式	上向流式
	空間速度	$SV_1=10$ [1/h]
		$SV_2=15$ [1/h]
	滞留時間	$1/SV_1=0.1$ [h]=6.0[min] (U-BCF(1))
		$1/SV_2=0.07$ [h]=4.2[min] (U-BCF(2))
	線速度	$LV=15$ [m/h]
	層厚	$H_A=LV/SV_1=1.5$ [m] (U-BCF-(1))
		$H_B=LV/SV_2=1.0$ [m] (U-BCF(2))
	支持砂利	ϕ 2-4 75 [mm]
		ϕ 4-7 75 [mm]
		ϕ 7-12 75 [mm]
		U-BCF ϕ 12-20 75 [mm]
②粒状活性炭 (GAC)	充填材	GAC (石炭系)
	有効径	0.4~0.5 [mm]
	均等係数	< 1.7
	充填密度	450~550 [kg/m ³]
	ヨウ素吸着量	> 1,000 [mg/g]
	硬度	> 95 [%]



パイロットプラント全景



粒状活性炭

2.3 実証実験を通じて得た課題、問題点

- ① Saigon 川の水質は以下に示す通り、ハイフォン市と比較し、pH、溶存酸素（以下、DO）が低い。

水質項目	Saigon 川 (ホーチミン市)	紅河水系 (ハイフォン市)
pH	6.4	7.2
DO (mg/L)	2.8	6.9

- ② 実証実験初期段階ではパイロットプラントが日光に晒される事でカラム内に藻が発生し、活性炭の見かけ比重が低下、その結果、逆洗時に活性炭の流出が起こっていた。
- ③ 実証実験を進める中で、パイロットプラントのカラム内の流量が十分ではなく、活性炭が十分に流動せず、カラム内に多くの泥が蓄積し、カラム内部で詰まっている状態であった。
- これらの問題に対し、検討を行い処理状況改善のために以下の改善策を実施した。

2.4 改善策の実施

1) 簡易ブローによる DO 改善、パイロットプラントの遮光

実施時期：2014 年 5 月

U-BCF は生物による自然浄化作用を利用して処理を行うため、U-BCF 施設内では塩素を使用することができない。このため、藻類が繁殖しやすい環境であることから、その繁殖が顕著となる場合、ろ過閉塞を引き起こす恐れがある。設置から 4 ヶ月を経過した際のカラム内部を確認したところ、藻類の付着が顕著に見受けられた。

Saigon 川は特徴として DO が低いことが挙げられる。U-BCF の能力低下を招く原因となっていることが考えられる。(DO : 0.3mg/L、2014 年 4 月 24 日測定)

このため、DO 改善と藻の発生抑制を図るため、簡易ブロー（原水分配槽内に設置）およびパイロットプラントの遮光を実施した。

	
簡易ブロー	簡易ブロー設置
	
パイロットプラント遮光	

上記改善策実施前後の DO を以下に示す。(測定時)

改造前	改造後
1.2 mg/L	<u>4.4 mg/L</u>

本改善策実施後、2 ヶ月程度 U-BCF によりアンモニア態窒素が良好に硝化されたが、8 月には硝化率が低下した。

2) 多段式トレイ設置、圧縮空気を使用した DO 改善策の実施

実施時期：2014 年 9 月

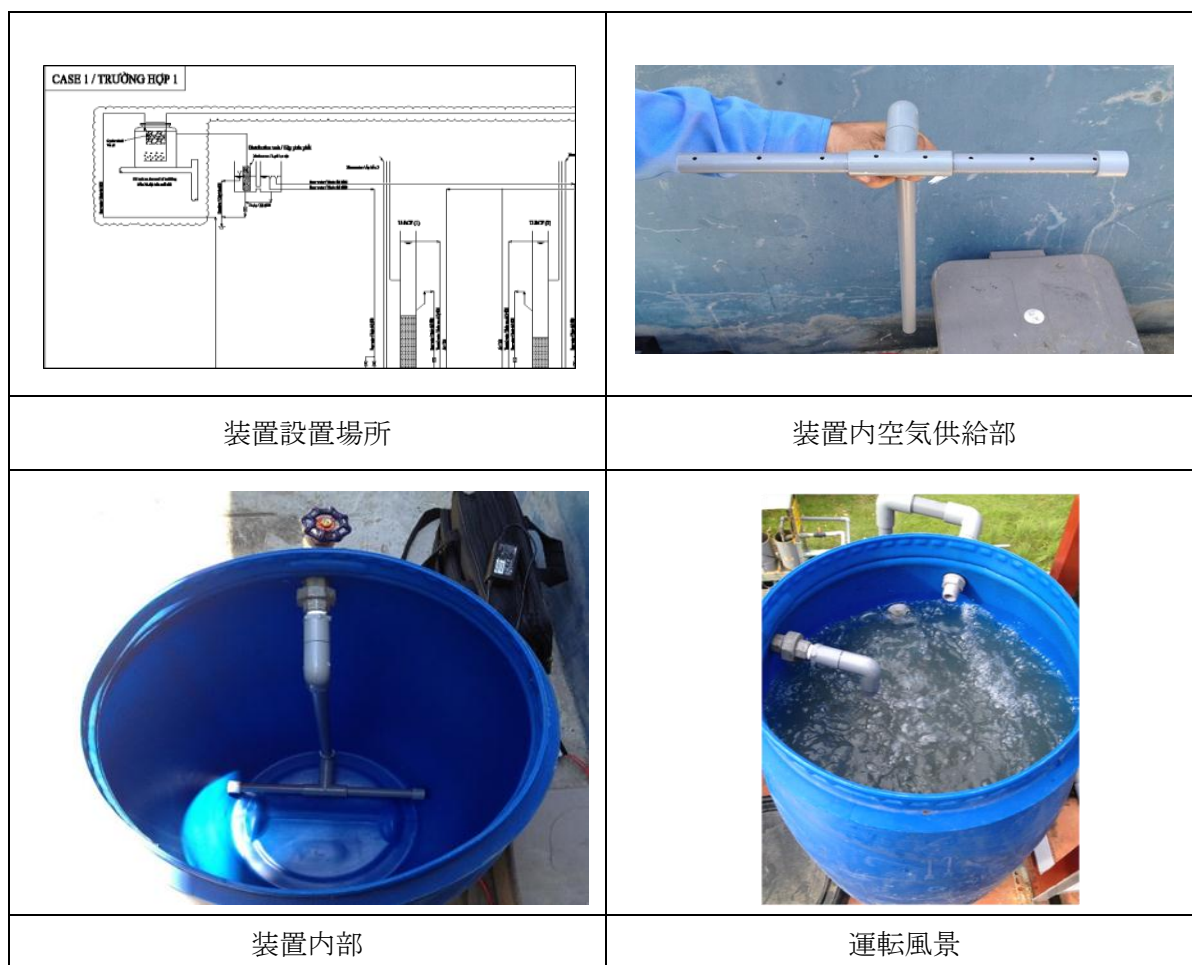
上記簡易ブロワーの設置による DO 上昇により一時的ではあるが処理状況の改善が見られた事から、本格的な DO 改善策を実施する事とした。

実施した改善策は多段式トレイ（図-2.2）、圧縮空気を使用したエアレーション装置（図-2.3）である。

図-2.2 多段式トレイ

多段式トレイ概略図	装置側面
原水流入部	装置全景

図-2.3 圧縮空気を使用したエアレーション装置



上記改善策実施後の DO の変化を以下に示す。(測定時)

改造前	改造後
1.25 mg/L	<u>7.5 mg/L</u>

本改善策実施後の処理状況を以下に示す。

表-2.2 パイロットプラント試験結果 (2014 年 10 月度、平均値)

水質項目	原水水質	U-BCF 処理水	
		水質	除去率
水温 (°C)	30.9	31.3	—
pH (—)	6.35	6.82	—
濁度 (NTU)	50.9	42.8	16%
E260 (—)	0.18	0.16	11%
アンモニア態窒素 (mg/L)	0.195	0.112	42%
溶存マンガン (mg/L)	0.026	0.010	62%
溶存鉄 (mg/L)	0.15	0.14	9%

表 1.5 にある 2 月度の処理状況と比較するとアンモニア態窒素、溶存マンガンの除去において改善が見られたが、日本国内、ハイフォン市等の実績と比較すると処理性能は十分でない。このことから、DO 以外で処理性能が上がらない原因を調査することとした。

3) 遺伝子解析 (PCR 法)

実施時期：2014 年 11 月

本報告書「1.4U-BCF 概要」にもあるように、U-BCF は装置内の粒状活性炭に付着した細菌によって、原水水質改善を行う。

上記改善策実施後も処理性能が十分に改善されなかったことから、本パイロットプラント内とハイフォン市 U-BCF 設備内の活性炭を採取し、細菌数を比較した。

細菌数は PCR 法により行った。

細菌検査の結果を以下に示す。

表-2.3 細菌数検査結果

サンプル名	硝化細菌				Fe・Mn酸化細菌		
	全細菌	アンモニア酸化細菌	アンモニア酸化古細菌	亜硝酸酸化細菌	鉄酸化細菌 <i>Crenothrix polyspora</i>	Mn酸化細菌 <i>Pedomicrobium & Hyphomicrobium</i>	鉄細菌 <i>Gallionella</i>
	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC
ハイフォン	2.67E+10	4.12E+07	5.88E+07	6.29E+08	下限以下	4.17E+08	下限以下
サイゴン水道公社	2.05E+10	1.43E+07	9.98E+07	6.60E+05	下限以下	6.78E+08	3.21E+05

図-2.4 細菌数比較 (サイゴン水道公社、ハイフォン)

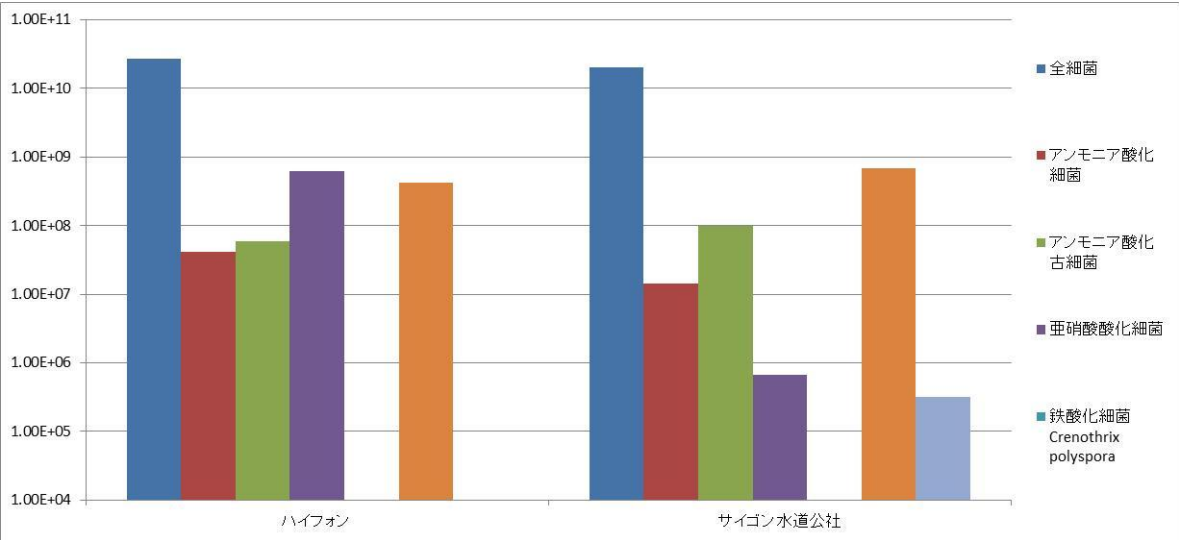


図-2.4 より、ハイフォン市とサイゴン水道公社の活性炭に生息する細菌の数に大きな違いは見られなかった。なお、ハイフォン市で稼働中の U-BCF の硝化は良好であることから、本実証実験の U-BCF は細菌学的に十分に硝化を行うことができるものと推測される。

4) 活性炭洗浄、パイロットプラント配水用孔の改造、計装機器等交換

実施時期：2014 年 12 月

現地調査時に U-BCF の状態を確認すると、活性炭の流動が不十分であったため、U-BCF を分解し、活性炭およびカラム内部の洗浄を実施した。

また、流動性が不均一のため、U-BCF 装置の配水部の改造を行った。

その他、パイロットプラント運転のために流量計（水、空気共）、流量調節用のバルブの交換、空気洗浄用圧縮空気ラインにミスト・オイルセパレーターを設置した。

・2014 年 12 月 22 日

SAWACO 担当者に北九州市上下水道局、(財)北九州上下水道協会、神鋼環境ソリューションで BCF の処理状況等のヒアリングを実施。

(於 Hoa Phu 取水場会議室)



行った作業は以下の通り。

・パイロットプラントの分解、活性炭およびカラム内の洗浄

	
活性炭抜き出し	活性炭への泥の蓄積が認められる



砂利にも多量の泥の付着が認められる



配水部にも多量の泥の付着が認められる



配水部にも多量の泥の付着が認められる



配水部にも多量の泥の付着が認められる



U-BCF カラム洗浄



パイロットプラント再組立

・活性炭の流動性を均一にするため、U-BCF 装置配水部の配水用孔を改造

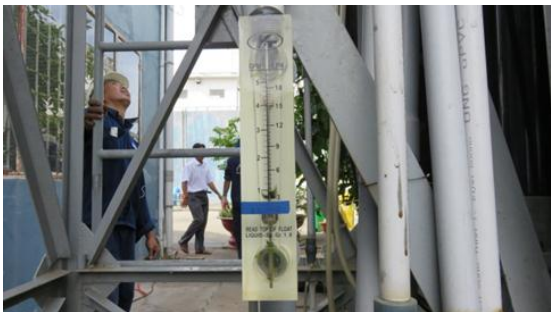
- 分配用孔を $\phi 6\text{mm} \times 4$ 個から $\phi 6\text{mm} \times 21$ 個に追加。
- 分配制限用筒の撤去



分配用孔改造	改造後分配用孔
	
分配制限用筒	改造完了

・流量計、バルブ交換

- 空気流量計を交換
- 水用流量計を交換
- 水量調節弁をボール弁からグローブ弁に変更
- 空気洗浄用減圧弁にミストセパレータ、オイルセパレータを設置

	
旧・空気流量計 LZT 製（中国）	新・空気流量計 東京計装製（日本）
	
旧・水用流量計 LZT 製（中国）	新・水用流量計 東京計装製（日本）

	
空気洗浄用減圧弁	ミストセパレータ、オイルセパレータの設置

本改善策実施後の処理状況を以下に示す。

表-2.4 パイロットプラント試験結果
(2014 年 12 月 25 日～2015 年 1 月 8 日までの 4 回測定の平均値)

水質項目	原水水質	U-BCF 処理水	
		水質	除去率
水温 (°C)	28.2	28.3	—
pH (—)	6.24	6.78	—
濁度 (NTU)	20.7	11.8	43%
E260 (—)	0.12	0.09	24%
アンモニア態窒素 (mg/L)	0.277	0.065	76%
溶存マンガン (mg/L)	0.038	0.007	81%
溶存鉄 (mg/L)	0.23	0.23	0%

上記の通り、アンモニア態窒素、溶存マンガンの除去について大幅な改善が見られた。

2.5 中間報告会

2014 年 9 月にサイゴン水道公社向けに中間報告会を行った。
概要を以下に示す。

- ・ 日時：2014 年 9 月 23 日（火） 9:00～11:45
- ・ 場所：サイゴン水道公社本社 会議室
- ・ サイゴン水道公社出席者：Mr. Chau（副総裁）、Mr. Triet（Tan Hiep 浄水場長）、
Mr. Thach（水質管理室副室長）、Ms. Thuy（水質管理係員）、その他職員
- ・ ハイフォン市水道公社出席者：Mr. Than（計画係員）
- ・ 北九州市上下水道局出席者：久保田和也（海外事業担当課長）
- ・ 北九州市上下水道協会出席者：原口公子（課長）

（日本側出席者敬称略）

サイゴン水道公社からは副総裁、浄水場場長、水質管理室副室長などが出席し、U-BCF に対する期待の高さが伺えた。

中間報告会では実験の現状についてを日本側から説明。

サイゴン水道公社からは水質・流量が大きく変動する Saigon 川で U-BCF がどの程度効果的なのか経過を見たい、アンモニア態窒素等の除去率が目標まで達していないが、それでも他の方法より効率が良いため経済効果がどうなるのかを計算して欲しい等様々な要望、意見があった。

本実験は日本の厚生労働省の補助を得て、今年度末までの事業であることを説明。

しかし、U-BCF の有効性を確認し、本設備の導入を進めるためにも来年度以降のデータ取得を継続したい旨を日本側より進言、Mr. Chau（副総裁）も賛成の意を示した。



中間報告会

2.6 最終報告会

2015 年 3 月に本実証実験の最終報告会を実施した。

来年度以降は JICA の支援を受けて、ホーチミンだけでなく他の都市への実証実験実施拡大も計画していることから、U-BCF の概要を理解して貰うために JICA ホーチミン連絡所にも出席を依頼した。

- ・ 日時：2015 年 3 月 12 日（木） 9：00～11：30
- ・ 場所：サイゴン水道公社本社 会議室
- ・ サイゴン水道公社出席者：Mr. Lam（総裁）、Mr. Giang（新副総裁）、Mr. Triet（Tan Hiep 浄水場長）、Mr. Thach（水質管理室副室長）、その他職員
- ・ ハイフォン市水道公社出席者：Mr. Duong（副総裁）、その他職員
- ・ JICA ホーチミン連絡所出席者：酒井利文（所長）、山田昭彦（シニアアドバイザー）、Ms. Bao（シニアアシスタント）
- ・ 北九州市上下水道局出席者：久保田和也（海外事業担当課長）、松本聡（海外事業課係長）、矢山将志（海外事業課）
- ・ 北九州市上下水道協会出席者：原口公子（課長）
- ・ 神鋼環境ソリューション出席者：田路明宏（課長）、宮川優毅（Kobelco Eco-Solutions Vietnam）

（日本側出席者敬称略）

サイゴン水道公社からは総裁、副総裁が出席し、U-BCF に対する力の入れ方を感じる事ができた。

報告会では”EVALUATION REPORT (DRAFT) 添付資料-5”を用いて、今までの実証実験での調査実施内容・実験結果、U-BCF 導入にかかる概算費用・ランニングコスト等について報告を行った。

今後のスケジュールとして JICA 支援による実証実験の継続および U-BCF をより深く理解してもらうための訪日研修実施を提案した。

サイゴン水道公社はハイフォン市水道公社での実績値レベルを期待しており「目標には達していないものの、U-BCF の一定の効果は認められた。しかし U-BCF の処理性能を向上させ、導入を検討するためには実証実験の継続が必要」として実証実験継続に同意、訪日研修についても歓迎の意を示した。

来年度以降の実証実験継続にあたり、処理効率が思うように伸びていない現状から、どのような対策を行い、本実証実験を成功に導くのか、次のステップに向けた具合案を提示するようサイゴン水道公社から要求があった。これについては対策を検討し、来年度実証実験の Kick Off Meeting で提案する旨回答した。

その他にもハイフォン市水道公社から、パイロットプラントのオペレーターとの交流・意見交換会の開催が提案されるなど、本実証実験成功に向けて大変有意義な報告会となった。

本報告会で使用した”EVALUATION REPORT (DRAFT) 添付資料-5”は報告会の最後に担

当者レベルでドラフト版へのサインが行われた。

最終版については各組織内で精査の上、後日代表者にてサインを行う事とした。



最終報告会



最終報告会

3. 調査結果のまとめ

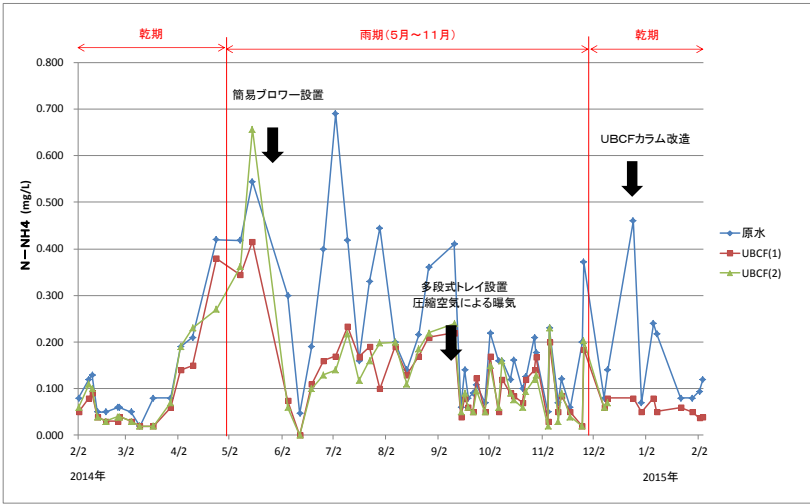
3.1 パイロットプラントによる処理状況および現地調査まとめ

現地での聞き取り調査から、取水地であるサイゴン川は9月から冬季にかけて、潮位が上がり、下流の汚濁水が遡り11月にCODがピークを示す一方、4月～7月は農業用に使用する水量が減少するため、上流にあるDau Tieng湖からサイゴン川へ大量の放流があり原水水質が好転することがわかった。

(1) アンモニア態窒素

Saigon川原水アンモニア態窒素濃度は、図-3.1に示すように、乾期で0.020～0.046mg/L（平均0.133mg/L）、雨期で0.047～0.69mg/L（平均0.220mg/L）であり、雨期には高い濃度となることが分かる。2014年の雨期に2度のDO改善工事を実施。一時的に良好な硝化結果が得られたが、U-BCF原水、処理水のDO改善のみでは十分な結果が得られなかった。その後、2014年12月にU-BCF実験カラムの改造を実施。その後、原水アンモニア態窒素の変動にも関わらず、その処理水濃度は低く安定している。また、現地によるとU-BCFの流動性が悪いとその除去率は低いとの報告があり、今後実証実験を継続するに当たり、U-BCF流動性（必要に応じて線速度の見直し）とその生物処理性を確認する必要がある。

図-3.1 アンモニア態窒素 経日変化



通期	N-NH4 (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	0.690	0.416	0.657
最小	0.020	0.000	0.000
平均	0.186	0.108	0.119

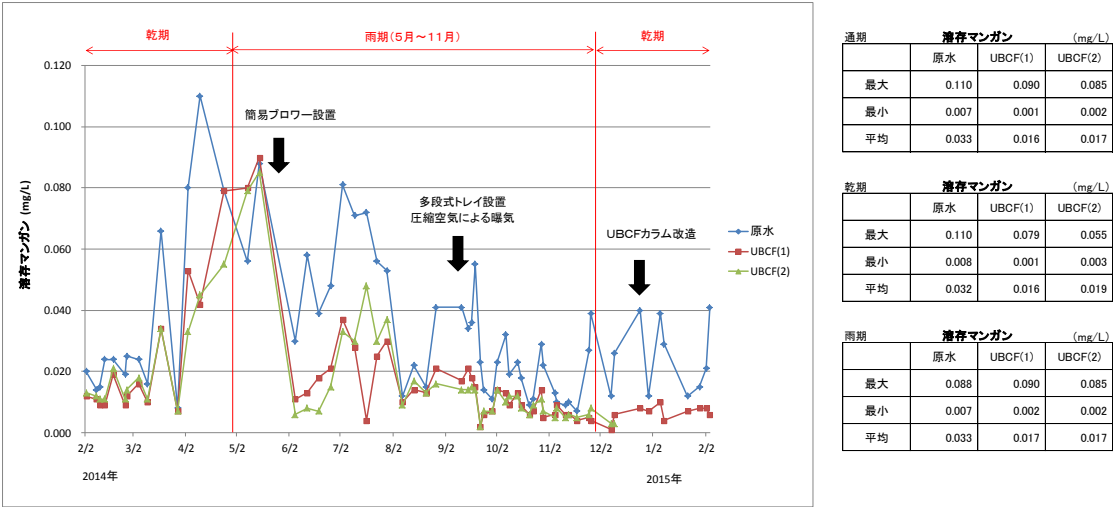
乾期	N-NH4 (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	0.460	0.380	0.270
最小	0.020	0.020	0.020
平均	0.133	0.073	0.086

雨期	N-NH4 (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	0.690	0.416	0.657
最小	0.047	0.000	0.000
平均	0.220	0.129	0.133

(2) 溶存マンガ

Saigon 川原水の溶存マンガ濃度は、図-3.2 に示すように、乾期で 0.008～0.110mg/L（平均 0.032mg/L）、雨期で 0.007～0.088mg/L（平均 0.033mg/L）であった。グラフから原水マンガ濃度は、雨期、乾期にあまり関係せず、通年平均の 0.033mg/L であった。溶存マンガ除去に関し、グラフより、これも U-BCF 原水と処理水の DO、U-BCF の流動性に関するものと思われる。

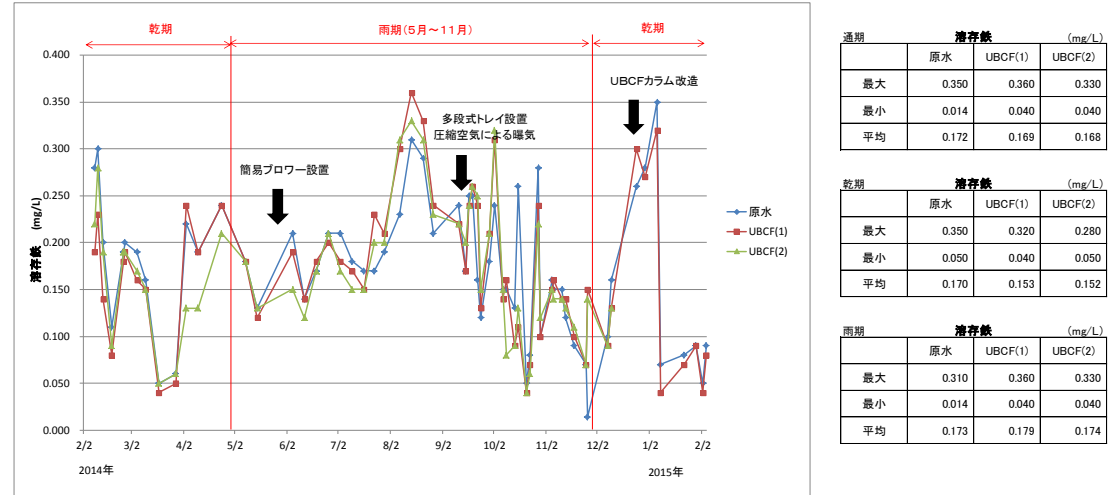
図-3.2 溶存マンガ 経日変化



(3) 溶存鉄

Saigon 川原水の溶存鉄濃度は、図-3.3 に示すように、月の変動はあるものの、雨期、乾期に関わらず変化せず、通年で 0.014～0.350mg/L（平均 0.017mg/L）であった。2.4 項で述べた通り、PCR での解析結果から U-BCF 担体には鉄細菌がほとんど検出されず、この結果からも U-BCF による鉄の除去はあまり期待できず、鉄の平均の除去率で通年で 2～3%程度である。

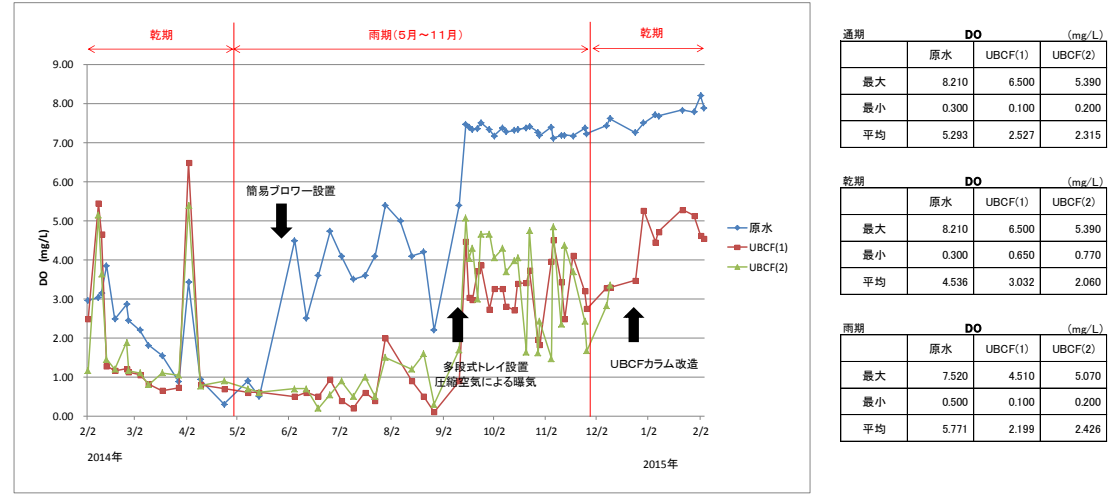
図-3.3 溶存鉄 経日変化



(4) DO

U-BCF は河川に生息する有用微生物を担体（粒状活性炭）に保持に原水水質改善を行うものである。この有用微生物は好気性であり、原水中の DO がその処理に影響を与える。実証実験当初、原水 DO が 0.3mg/L と低く、生物処理が悪化したが、その後 2 度に渡る DO 改善対策（2014 年 5 月 26 日、2014 年 9 月 10 日実施）の結果、図-3.4 から分かるように、原水、U-BCF 処理水の DO は大幅に改善された。しかし、先述のように生物処理においてその DO も重要であるが、これと共に U-BCF の流動性も重要であると考ええる。今後の実証実験を通じ、これらを十分に検証する必要がある。

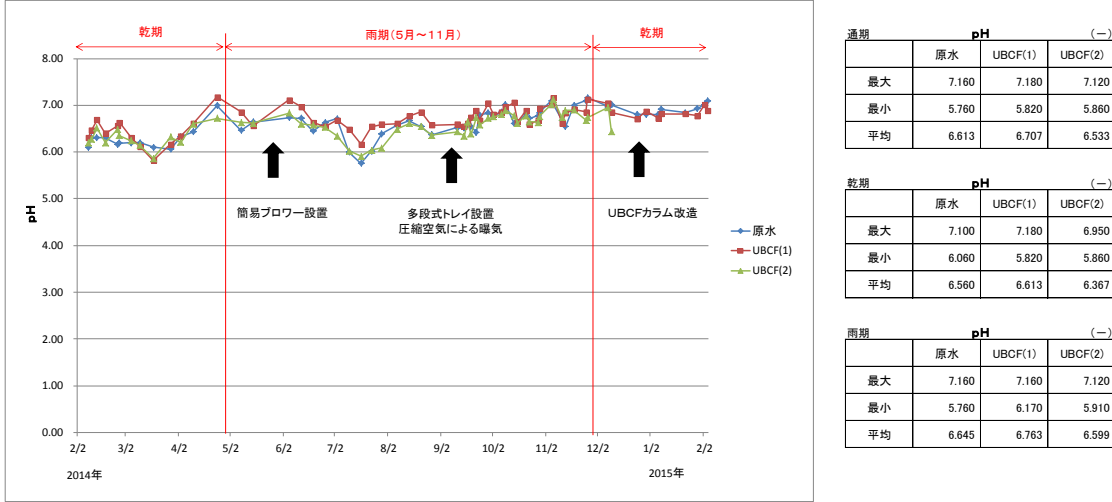
図-3.4 DO 経日変化



(5) pH

pH の経日変化を図-3.5 に示す。実証実験開始当初、問題となった低 DO、低 pH に関しては 2 度の DO 改善策に伴い、原水 pH も改善された。特に、2014 年 9 月に実施した多段式トレイ設置と圧縮空気による pH 改善は顕著であり、将来、本法を実施設に導入することで大幅な薬品削減となることが期待される。

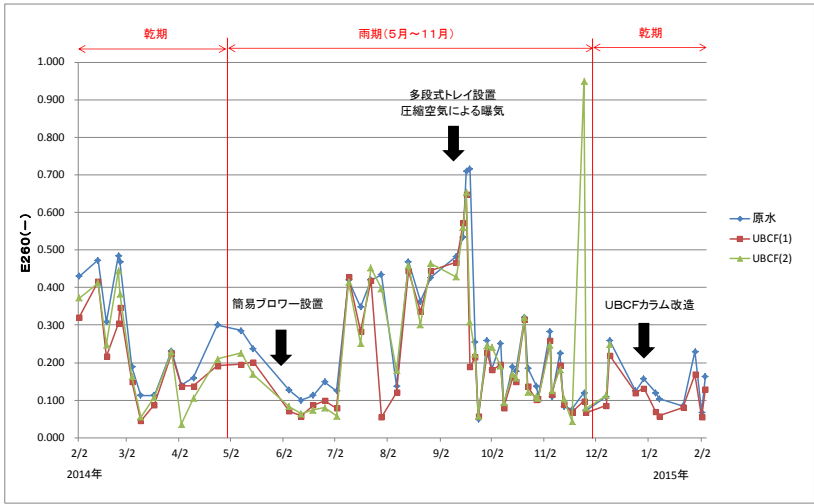
図-3.5 pH 経日変化



(6) E260

図-3.6 に E260 の経日変化を示す。原水の E260 は、乾期で 0.068～0.485(－) (平均:0.220(－))、雨期で 0.050～0.716(－) (平均:0.257) と雨期で高い値となった。これは雨期の高濁度によるものと推測される。U-BCF の処理性能は、滞留時間の長い U-BCF(1)の E260 除去率が 24%と U-BCF(2)より高くなり、水道原水の有機物改善には空間速度(SV)は 10(l/h)必要であることが分かる。

図-3.6 E260 経日変化



通期	E260 (－)		
	原水	UBCF(1)	UBCF(2)
最大	0.716	0.649	0.950
最小	0.050	0.045	0.036
平均	0.244	0.195	0.241

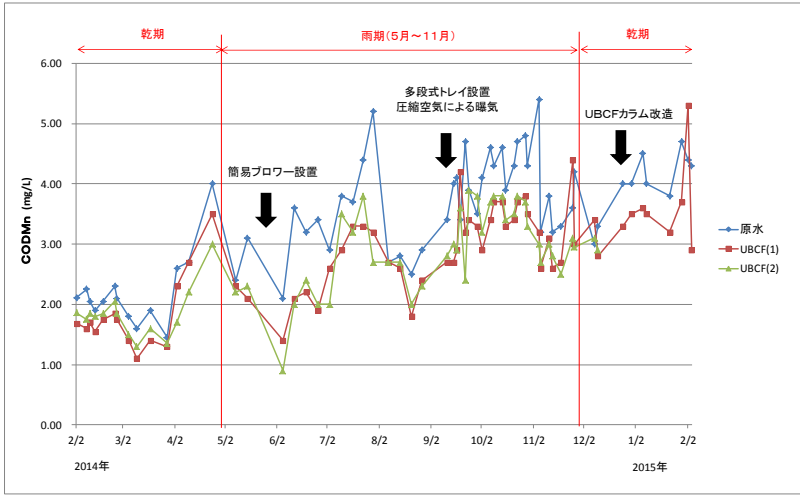
乾期	E260 (－)		
	原水	UBCF(1)	UBCF(2)
最大	0.485	0.416	0.445
最小	0.068	0.045	0.036
平均	0.220	0.168	0.223

雨期	E260 (－)		
	原水	UBCF(1)	UBCF(2)
最大	0.716	0.649	0.950
最小	0.050	0.055	0.044
平均	0.257	0.211	0.247

(7) COD_{Mn}

図-3.7 に COD_{Mn} の経日変化を示す。Saigon 川原水において雨期で 2.10～5.40mg/L (平均 3.74mg/L)、乾期で 1.45～4.70mg/L (平均 2.95mg/L) と乾期で高い CDO_{Mn} となった。雨期の U-BCF 処理水の COD_{Mn} は 1.40～4.40mg/L (平均 2.95mg/L) と原水水質改善効果が認められ、雨期での U-BCF による COD_{Mn} の平均の除去率 20～25%が得られた。

図-3.7 COD_{Mn} 経日変化



通期	CODMn (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	5.40	5.30	3.90
最小	1.45	1.10	0.90
平均	3.43	2.79	2.65

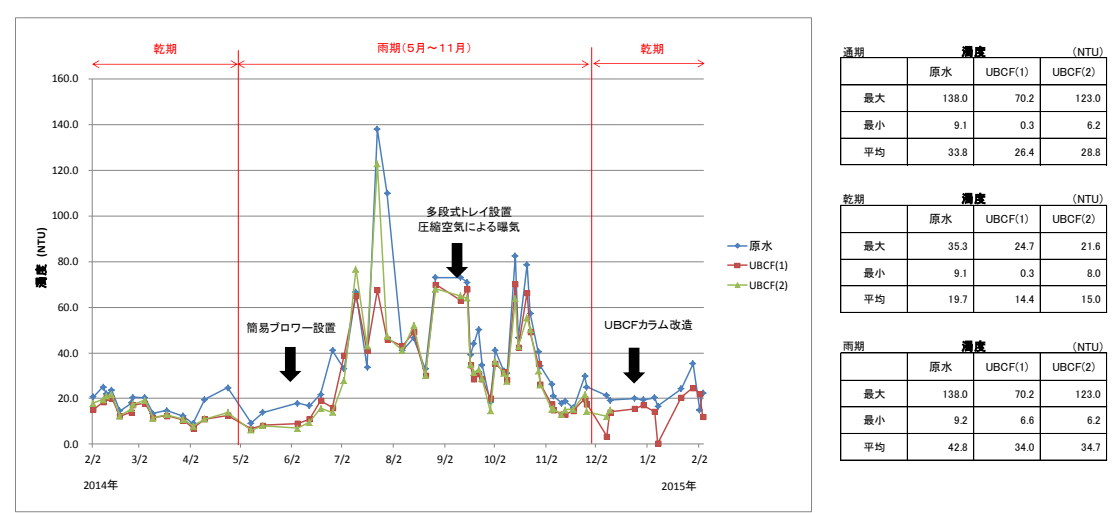
乾期	CODMn (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	4.70	5.30	3.10
最小	1.45	1.10	1.30
平均	2.95	2.53	1.98

雨期	CODMn (mg/L)		
	原水	UBCF(1)	UBCF(2)
最大	5.40	4.40	3.90
最小	2.10	1.40	0.90
平均	3.74	2.95	2.93

(8) 濁度、色度

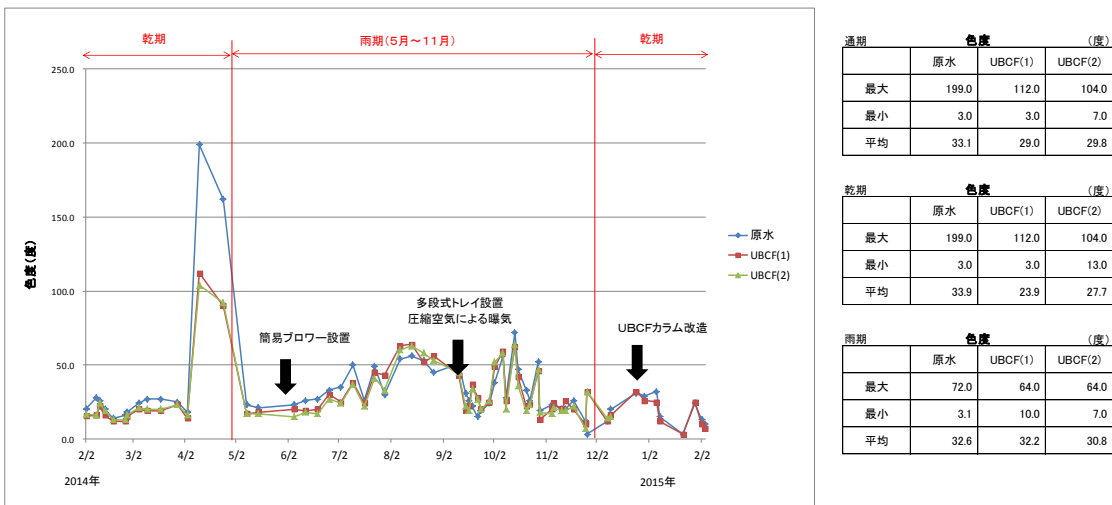
・濁度は図-3.8 に示すように、雨期で 9.2～138 度（平均 42.8 度）、乾期で 9.1～35.3 度（平均 19.7 度）となり、雨期では原水濁度が高い結果となった。2014 年 12 月に実施した U-BCF カラム改造により、活性炭、砂利、配水部に多量の泥の付着が認められている。安定的な生物処理を行うためには、濁質を捕捉しないことが肝要であり、今後洗浄方法を含めて検討する必要がある。

図-3.8 濁度 経日変化



・色度は図-3.9 に示すように、雨期に若干高くなる傾向が認められるものの、通年で原水色度は 33 度程度、U-BCF 処理水 29 度程度とその除去率は 10%程度であった。

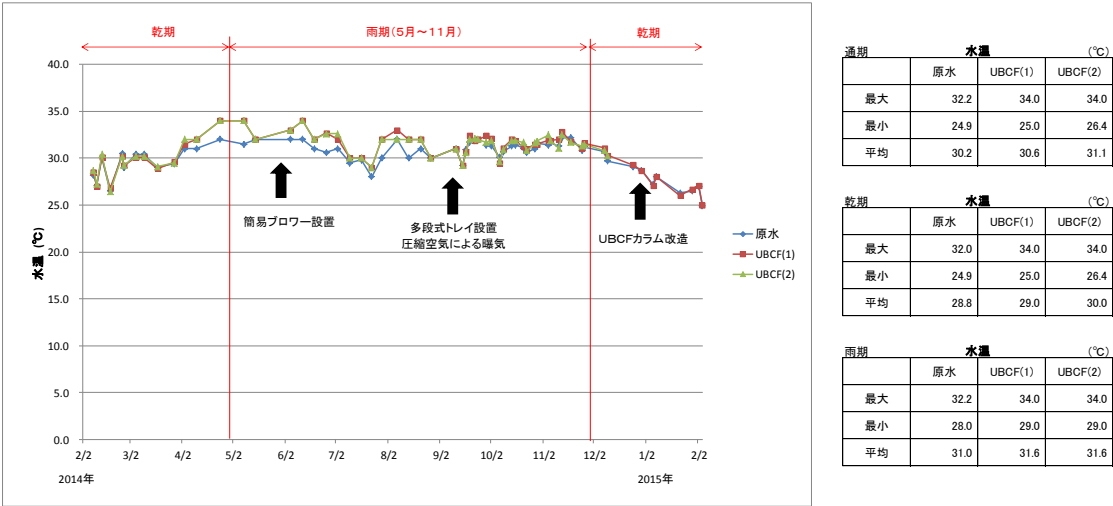
図-3.9 色度 経日変化



(9) 水温

図-3.10 に水温の経日変化を示す。水温に関しては、雨期、乾期での変化は認められない。但し、2015 年 1 月～2 月にかけて水温の減少（30.0℃→25.0℃）が認められた。通年の水温は 24.9～32.2℃（平均 30.2℃）であった。

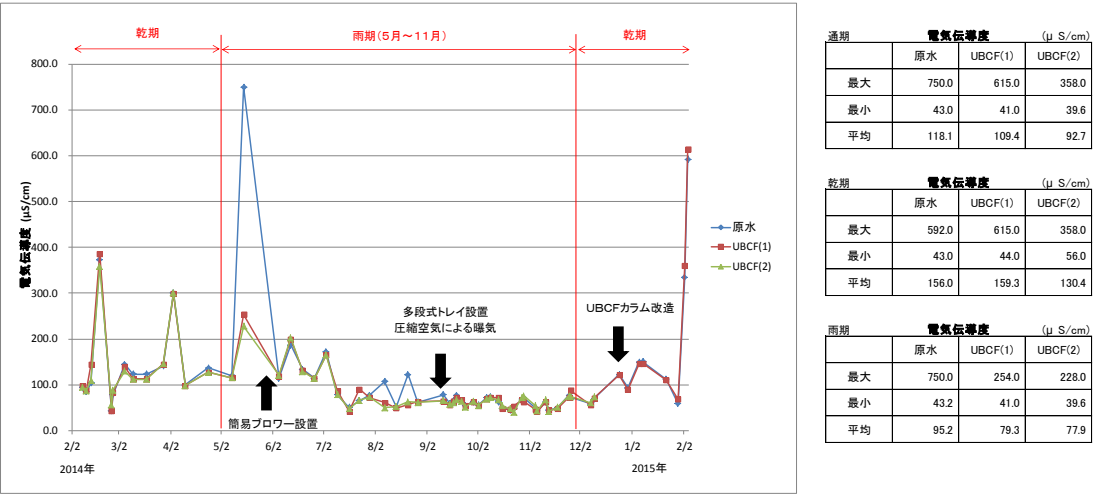
図-3.10 水温 経日変化



(10) 電気伝導度

図-3.11 に電気伝導度経日変化を示す。雨期で 43.2～750 μ S/cm（平均 95.2 μ S/cm）、乾期で 43.0～592.0 μ S/cm（平均 156.0 μ S/cm）と乾期で若干高い電気伝導度となった。

図-3.11 電気伝導度 経日変化



3.2 今後の展望について

上述の通り、雨期においてもアンモニア態窒素、溶存マンガン及び COD_{Mn} 等の原水水質改善効果に関して U-BCF の有効性が証明された。

アンモニア態窒素等の除去率は目標には達していないが、2014 年 12 月の改善策実施後に処理性能の大幅な改善が見られた事からサイゴン水道公社側の期待も大きくなっていると感じる。その表れとして実証実験継続についても合意を得ることができた。

U-BCF の有効性をサイゴン水道公社に認識してもらい、本設備の導入へ結びつけるには継続して実証実験を行い安定した処理性能を示す必要があると考える。

サイゴン川の水質悪化に伴って、生活排水の影響を受けにくい上流の Dau Tieng 湖まで導水管を伸ばす計画もあるが、打合せの中でサイゴン水道公社から「費用の面から見ても非常に困難」との発言があり、U-BCF に対する期待は依然として大きい。

上記の事から、引き続き実験のデータを取り続ける事としたい。

4. 事業形成の可能性

4.1 事業をとりまく環境

現政権は、3本の矢のうちの1つである成長戦略「日本再興戦略」を平成25年6月14日に閣議決定し、海外市場獲得のための戦略的取組として、インフラ輸出のトップセールスを積極的に行うとしている。

平成26年に改訂された「インフラシステム輸出戦略」でも官民連携体制を強化し、日本の先進的な技術を生かした「機器」の売り込みや建設・プラント事業の受注といった「川中」での取り組みのみならず、案件発掘・形成等「川上」や、施設の運営・維持管理やサービスの対価徴収といった「川下」に至る一貫した取り組みに対し、各フェーズのリスク特性を踏まえた支援を行い、案件受注につなげると明言されている。

特に「中国・ASEAN」地域については日本にとって「絶対に失えない、負けられない市場」としており現政権の同地域に対する期待が見て取れる。

U-BCFは今後の「中国・ASEAN」地域のインフラ整備において、その安全性・コストメリットから高いニーズ、評価を得られるものと考えている。

ハイフォン市水道公社では既にU-BCFが導入されており、今後も同技術をベトナム全土に広げているために現地調査、ニーズ発掘を進めて行く事としている。

このような状況において、北九州市上下水道局は、上述1.3にもあるように、独立行政法人国際協力機構（JICA）草の根技術協力事業（2010年度～2012年度）でU-BCFに係る技術移転を実施したことから、ハイフォン市水道公社をベトナム国におけるU-BCF普及に向けた取り組みを行うパートナーとして相互協力協定を締結している。

また、このU-BCF整備を日本の水ビジネス案件としてまとめあげる場合、ベトナム国の経済情勢（2013年の実質GDP成長率が5.4%と比較的高い水準にあるが、依然として高いインフレ率等）や外国企業の参入に関する法的手続き、税務の規制・制度などについて留意することが必要である。

4.2 資金調達について

サイゴン水道公社はベトナム最大の人口を抱えるホーチミン市への給水を行っている水道事業体である。同公社の年間料金収入は100MillionUS\$を上る事から、比較的大きな事業にも取り組むことのできる収入基盤を有しているといえる。

本格的な整備事業に向けた資金調達については、U-BCFの実証実験と平行しながら協議を進めることが必要である。

サイゴン水道公社の意向も踏まえながら公的資金、民間資金活用について検討していく。

4.3 TAN HIEP 浄水場 U-BCF 導入に係る試算

(Final Reporting for U-BCF Pilot Study in Tan Hiep WTP 北九州市上下水道局作成より抜粋)

(1) U-BCF 建設費 (概算)

Tan Hiep 浄水場の現在の処理能力は 30 万 m³/日である。今回、施設能力 30 万 m³/日の U-BCF 施設を Tan Hiep 浄水場に整備する場合の建設コストを試算する。(添付資料-3)

試算方法は、日本での導入実績を基準として施設能力比で算出し、またベトナム国での施工を考慮して算出する。

表-4.1 建設費 (概算)

		Cost (USD)
Comission	Designing	576,761
	Sub-total	576,761
Construction	Civil Work	8,898,592
	Mecanical Work	7,098,592
	Erectrical Work	4,170,423
	Monitoring Work	754,225
	Building	554,367
	Field Work	337,183
	Sub-total	21,813,382
Administrative Fee		42,254
Total		22,432,397 (USD)

U-BCF は浄水場の前段に設置される施設で、既存の浄水場の改造は、基本的には不要である。躯体はコンクリート構造物となるため、土木工事が全体工事費の約 40%を占める。また、この試算は概算であり、設置条件、物価上昇率等によって変動する。

(2) U-BCF ランニングコスト

Tan Hiep に U-BCF 施設を導入した場合の運転維持管理費を試算する。維持管理費として計上する主な費目として、以下の 3 項目を計上した。

① 電力費

U-BCF は上向流式であるが、自然流下方式を採用しているため、運転時には電力を必要としない。電力費用としては、洗浄時のエアブロー、排水ポンプ、電動弁や照明等を計上する。

② 粒状活性炭

U-BCF で使用する活性炭 (GAC) は、吸着性能を使うのではなく、生物の住処として使用するため、活性炭を交換する必要はない。しかしながら、洗浄過程や活性炭同士の磨耗等によって少しずつ目減りしていくことが想定される。そこで年間 7%の活性炭補充量を見込んでいる。

③ 維持管理費

U-BCF 施設はポンプ設備や電動バルブが設置される。故障無く運転するためには、日々のメンテナンスが必要不可欠である。これまでの実績から、20VND/m³を見込んでいる。

以上の試算に基づき、運転維持管理費を試算すると、表-4.2 に示すとおり、年間 4,272,221,430VND (205,791USD) が U-BCF の運転維持管理費が試算された。処理量 1m³ 当たりに換算すると、**39VND/m³**と試算される。

表-4.2 U-BCF ランニングコスト

Contents	Volume	Number	Operation Time	Annual Electric Cost 365 days	Electric Fee for 1kw	Annual Consumption
	kw	Num.	min or hour	kwh/year	VND/kw	VND/year
1 . Air Blower	37	3	30 min	20,257.5	1,929	39,077,000
2 . Dust Blower	7.5	3	24 hrs	197,100.0	1,929	380,206,000
3 . Discharging	11	6	2 hrs	48,180.0	1,929	92,939,000
4 . Valve	0.2	9	10 min	109.5	1,929	211,200
5 . Lightning	0.1	30	2 hrs	2,190.0	1,929	4,225,000
Sub-Total				267,837.0		516,658,200
Contents	Volume	GAC Life Time	Annual Rate Replenish	Annual Replenish Volume	Unit Cost	Annual Consumption Price
	m ³	year	%	m ³ /year	VND/m ³	VND/year
1 . GAC	1260	15	7 %	88.2	17,750,150	1,565,563,230
Sub-Total						1,565,563,230
Contents	Volume		Annual Operating Rate	Annual Operating Volume	Unit Cost	Annual Maintenance Price
	m ³ /day		%	m ³ /Year	VND/m ³	VND/year
1 . Mechanic	300,000	-	100 %	109,500,000	20	2,190,000,000
Sub-Total						2,190,000,000
Total(VND)						4,272,221,430
Total(USD)						205,791

(3) U-BCF 導入効果

U-BCF を導入することで、原水中に含まれるアンモニア態窒素、溶存マンガ、有機物が効果的に除去され、通常の浄水処理過程において必要となる塩素や凝集材等の薬品注入量の削減が期待される。日本での U-BCF の運転実績によると、年間注入量の約 30%が削減される。

現時点の実証実験結果を踏まえた場合の薬品注入量の削減効果は表-4.3 に示すとおりで、年間 1,652,795,000VND (79,614USD)の経費削減が期待される。また、U-BCF が本来の除去効果を十分に発揮した場合、表-4.4 に示すとおり、年間 3,541,703,000VND (170,602USD)前の経費削減が期待される。

表-4.3 年間薬品削減費

Contents	U-BCF Treatment Volume	Dosage	Reduction Rate	Annual Reduction Volume 365days	Unit Cost	Annual Chemical Reduction Cost
	m3/day	g/m3	%	kg/year	VND/kg	VND/year
1 . PAC	300,000	24.4	14	374,052	2,976	1,113,179,000
2 . Chlorine	300,000	2.75	14	42,158	12,800	539,616,000
Total(VND)						1,652,795,000
Total(USD)						79,614

表-4.4 年間薬品削減費

Contents	U-BCF Treatment Volume	Dosage	Reduction Rate	Annual Reduction Volume 365days	Unit Cost	Annual Chemical Reduction Cost
	m3/day	g/m3	%	kg/year	VND/kg	VND/year
1 . PAC	300,000	24.4	30	801,540	2,976	2,385,383,000
2 . Chlorine	300,000	2.75	30	90,338	12,800	1,156,320,000
Total(VND)						3,541,703,000
Total(USD)						170,602

また、有機物が削減されることにより、給水中に含まれるトリハロメタン（THM）の値についても削減が期待され、水の安全性が向上する。北九州市のこれまでの実績から、トリハロメタンの約 30%の削減が期待される。

4.4 想定される事業内容

上記事業の推進にあたっては北九州市上下水道局だけでなく、既に納入実績のあるハイフォン市水道公社から協力を得る事で、G to G による強力な後押しができるものと考えている。

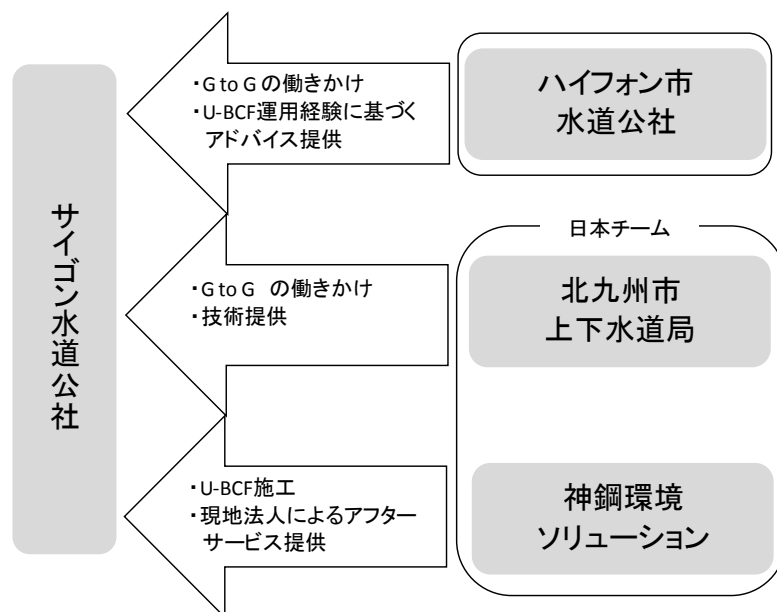


図-4.1 U-BCF 協力体制

4.5 事業形成に向けての今後の活動計画

今回の調査を通じ、U-BCF 適応可能性について一定の評価を得ることが出来、調査については非常に有益であった。今後は、以下の計画に基づき活動を行い、事業形成を具体化していく。

- ① パイロットプラントの運転、処理状況の確認を継続し、ホーチミンでの U-BCF の有効性を証明する。
- ② サイゴン水道公社との打合せを進め、導入までの具体的スケジュールの立案を行う。
- ③ サイゴン水道公社との打合せを進め、より具体的な導入コストを算出、事業化に向けた提案を行う。
- ④ 施設納入後のアフターサービスについても提案を行い、長期的な事業形成を目指す。

今後の想定スケジュールを以下に示す。

サイゴン水道公社とは来年度も継続して実証実験を行う事で合意しており、4 月にキックオフミーティング（KOM）を開催、5 月には訪日研修として日本で実際の U-BCF を用いて運転・維持管理等の研修を行う。

2016 年 6 月を目途に最終評価会を開催し、U-BCF 導入に向けた協議を行う。

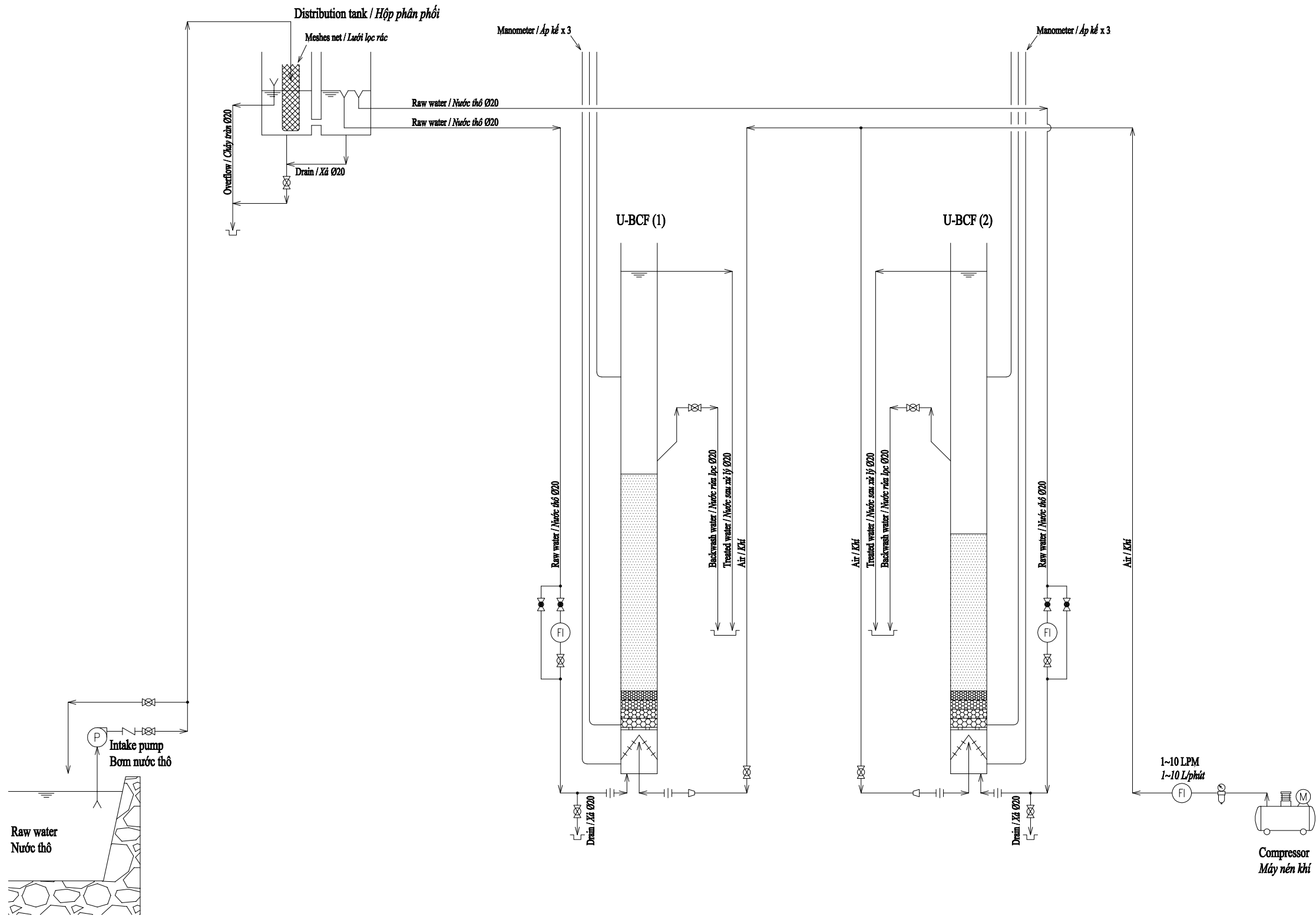
		2015年							2016年		
		4月	5月	6月	7月	8月	9月	10月	……………	5月	6月
日本側	神鋼環境ソリューション	KOM	訪日研修		現地調査			→		U-BCF導入に向けた プロポーサル作成	最終評価会
	北九州市上下水道局	KOM	訪日研修		現地調査			→		U-BCF導入に向けた プロポーサル作成	最終評価会
ベトナム側	サイゴン水道公社	実証実験・運転維持管理									→
		KOM	訪日研修								
	ハイフォン水道公社	KOM	訪日研修		現地調査			→			最終評価会
		↑ 水質が悪化する7月～10月を目途に 現地調査を行う									

図-4.2 全体スケジュール

以上

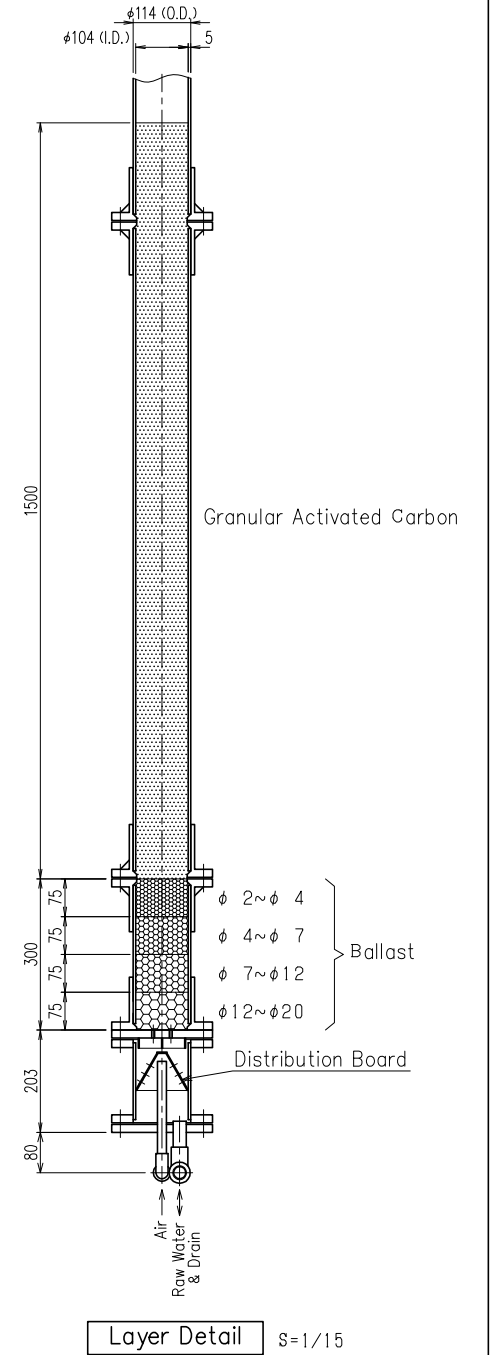
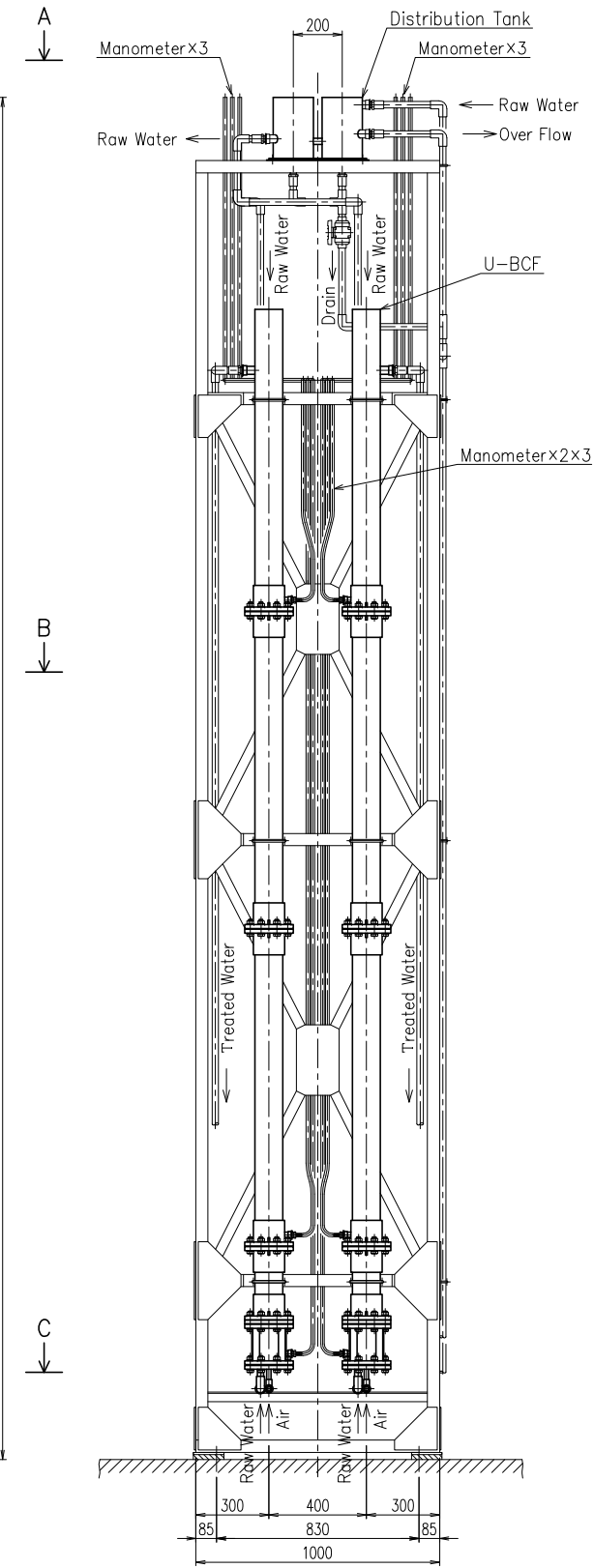
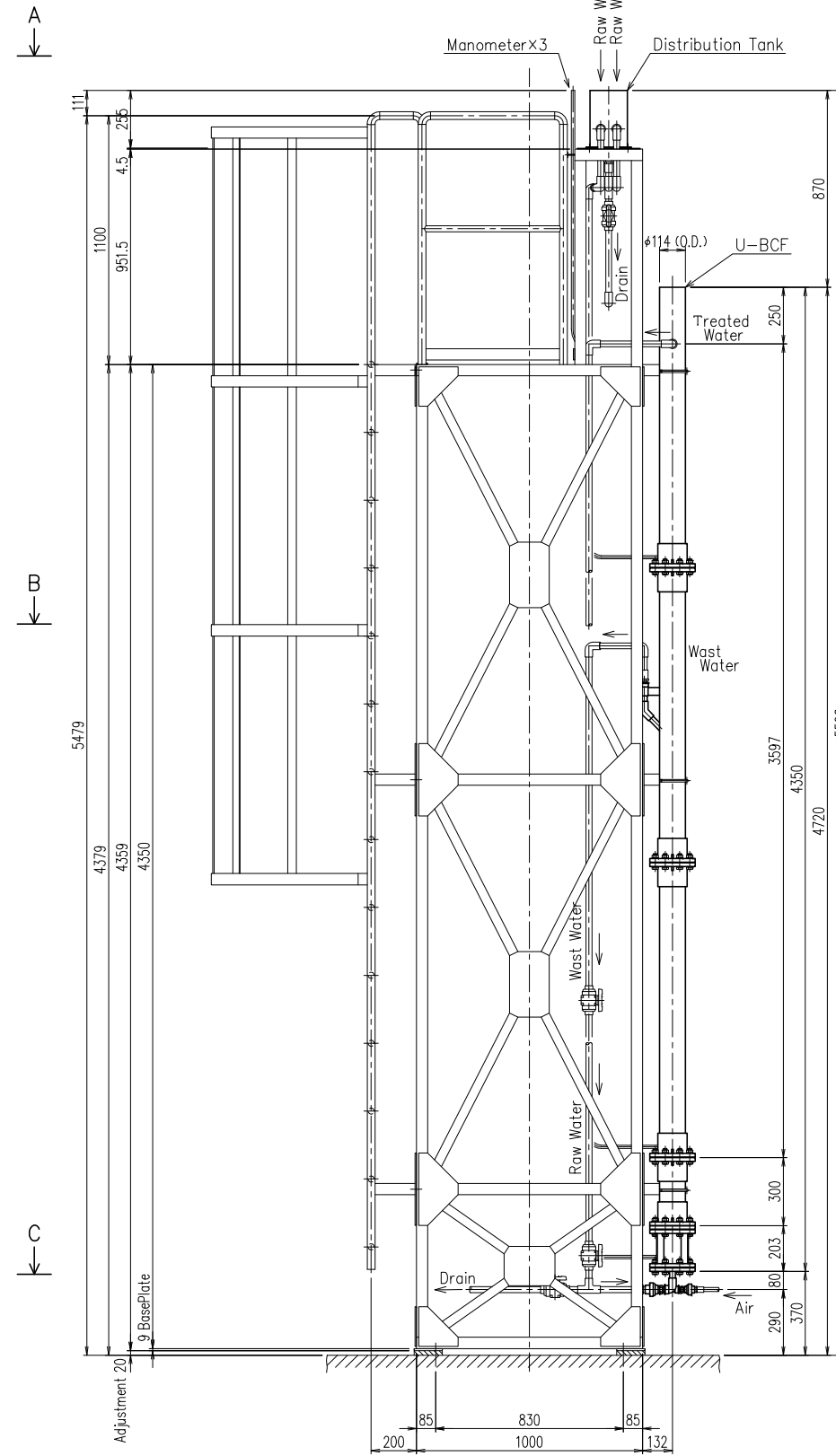
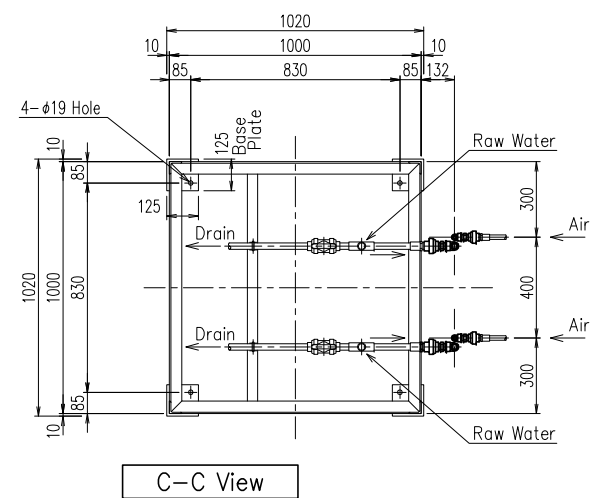
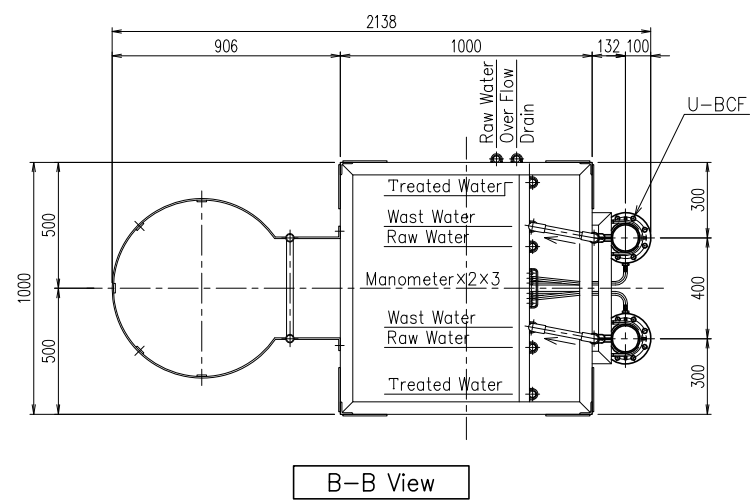
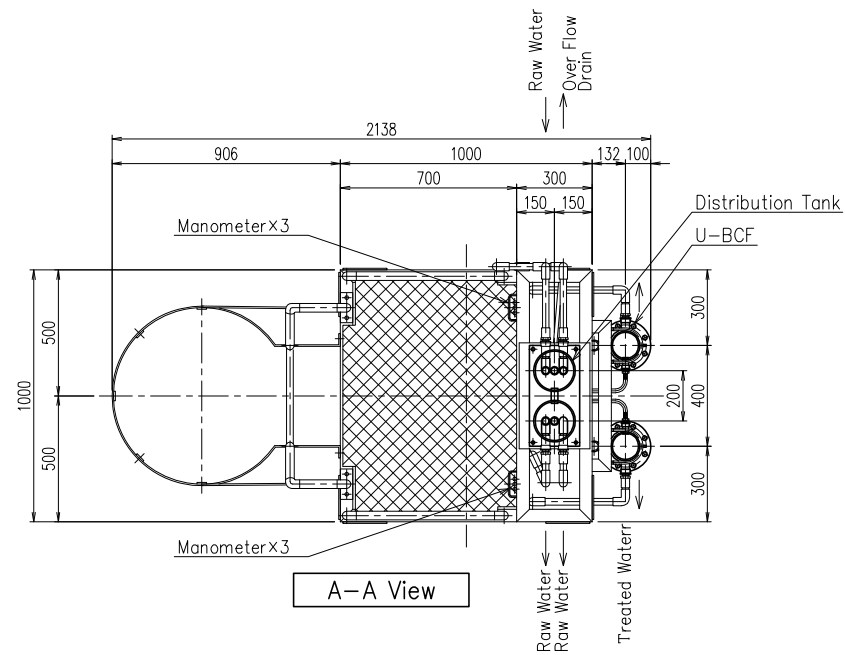
添付資料－ 1

- ・ 実証実験 フローシート
- ・ U-BCF 組立図



Symbol Biểu tượng	Name Tên thiết bị
⊗	Ball valve / Van bi
⊕	Globe valve / Van cầu
⊗	Needle valve / Van kim
⌞	Check valve / Van một chiều
— — —	Prefab joint / Nối nhanh
⊗	Flow meter / Lưu lượng kế
⊗	Filter regulator / Lọc và điều áp

Flow Diagram of Biologically Experimentation, Vietnam
Sơ đồ hệ thống thử nghiệm bằng phương pháp lọc sinh học tiếp xúc, Việt Nam



添付資料－ 2

- ・ U-BCF 仕様、概略配置図

基本設備仕様 (機械設備)

1. 機械設備工事

1) 基本事項

(1) 設備概要

Saigon川原水に含まれるアンモニア態窒素、及び原水水質改善を図るため、既設（凝集沈澱＋急速ろ過）の前段にU-BCFを設置する。なお、Saigon川の特性として、原水DOが低いため、U-BCFの前段に流下式溶存酸素接触槽を設けるものとする。

生物接触ろ過設備は、自然界に存在する微生物の浄化作用により処理を行う。

微生物を生息させるための担体は粒状活性炭とし、これに上向流で原水を通過させることで、懸濁物質は極力捕捉せずに溶融物物質のみを効率的に除去する。洗浄は水（原水）と空気を併用する。

(2) 計画最大浄水量

$$300,000 \text{ m}^3/\text{日} = 12,500 \text{ m}^3/\text{時} = 208.3 \text{ m}^3/\text{分}$$

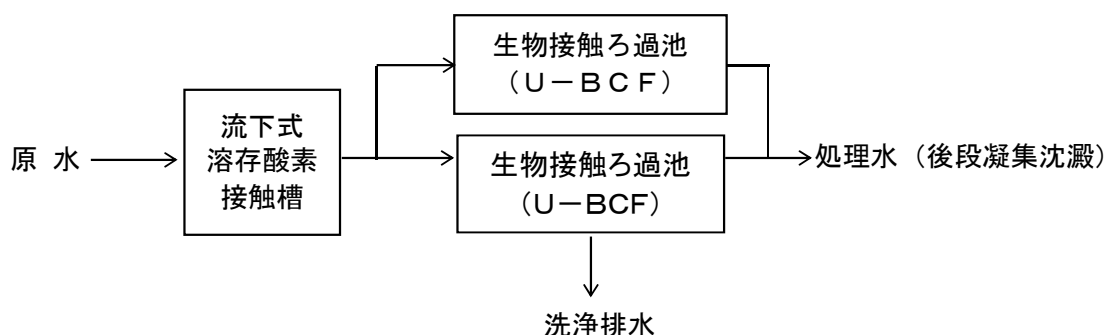
(3) 水 源

Saigon川原水

(4) 処理方式

上向流生物接触ろ過方式（U-BCF）

(5) 概略フロー



2) 生物接触ろ過設備 (U-B C F) 機器仕様

(1) 生物接触ろ過池

型 式	上向流式
池 数	8 池/系統 × 2 系統
池 寸 法	4.5 m ^W × 6.0 m ^L /室 × 2 室/池 × 8 池/系統 × 2 系統
池 面 積	864 m ² (1 池あたり 54 m ²)
通水速度	347 m/日 (LV= 14.5 m/時、SV= 9.6 l/時)
洗浄方法	水 (原水)、空気による洗浄

① 接触層

粒状活性炭による上向流接触ろ過とし、接触層の仕様は下記の通りとする。

種 類	石炭系粒状活性炭 (破碎炭)
有 効 径	0.4 ~ 0.5 mm
均等係数	1.7 以下
充填層高	1.5 m

② 支持層

支持層はろ過砂利とする。形状は球に近く、硬質、清浄で均等なものとする。

1 層	粒 径	2 mm ~ 4 mm	75 mm 厚
2 層		4 mm ~ 7 mm	75 mm 厚
3 層		7 mm ~ 12 mm	75 mm 厚
4 層		12 mm ~ 20 mm	75 mm 厚
			計 300 mm 厚

③ 下部配水装置

原水の均等配水および洗浄空気の均等分配を行い、水頭損失を小さく、かつ水圧の均一化を図り、ろ層の洗浄を効果的に行うものとする。

型 式	多孔板式		
構 造	清掃（人力）容易な構造とする		
材 質	SUS304		
数 量	2 基/池		
設置面積	864 m ² （1 池あたり 54 m ² ）		
付 属 品	サポート	SUS304	1 式
	取付金具	SUS304	1 式
	アンカーボルト	SUS304	1 式
	空洗装置	SUS304	2 基/池

④ 集水トラフ

本トラフは、処理水を均等に集水するために設ける。

型 式	U字型トラフ		
寸 法	400 mm ^W × 430 mm ^H × 4,700 mm ^L		
材 質	SUS304		
数 量	1池あたり 6 本		
付 属 品	サポート	SUS304	1 式
	取付金具	SUS304	1 式
	アンカーボルト	SUS304	1 式

⑤ ヒンジ付マンホール

圧力渠への出入口用として設ける。

型 式	JIS10KF ヒンジ付マンホール
寸 法	φ 1000
材 質	SUS304
数 量	4 組

(2) 空洗ブローア

本機は、生物接触ろ過池の洗浄工程における、空気洗浄、気水洗浄工程での洗浄用空気を送気するために設ける。

型 式	ルーツブロー		
台 数	4 台（1系統に1台、予備1台）		
吐 出 量	65.1 m ³ /分		
吐 出 圧	58.8 kPa		
材 質	ケーシング	FC相当	
	ローター	FC相当	
	シャフト	炭素鋼相当	
電 動 機	全閉外扇屋内型（インバータ制御）		
	90 kW 、 3 相 、 AC 400 V、50 Hz		
付 属 品	共通架台（防振台付）		1 組/台
	吸込サイレンサー		1 組/台
	吐出サイレンサー		1 組/台
	圧力計及び圧力計用スタンド		1 組/台
	安全弁及び取付用短管		1 組/台
	逆止弁		1 組/台
	防振継手		1 組/台

(3) 除塵ブロワ

原水中の塵芥物、魚等をU-BCF下部配水部へ進入を防ぐために設置する。

型 式	ルーツブロワー	
台 数	4 台 (1系統に1台、1台予備)	
吐 出 量	8.0 m ³ /分	
吐 出 圧	30 kPa	
材 質	ケーシング	FC相当
	ローター	FC相当
	シャフト	炭素鋼相当
電 動 機	全閉外扇屋内型 (インバータ制御) 7.5 kW、3 相、AC 400 V、50 Hz	
付 属 品	共通架台 (防振台付)	1 組/台
	吸込サイレンサー	1 組/台
	吐出サイレンサー	1 組/台
	圧力計及び圧力計用スタンド	1 組/台
	安全弁及び取付用短管	1 組/台
	逆止弁	1 組/台
	防振継手	1 組/台

(4) 流入量調整装置

本装置は、生物接触ろ過池へ流入する原水流量を設定値に調整するために設ける。

① 原水弁 (ろ過池流量調整弁)

型 式	電動バタフライ弁 (フランジレス)	
口 径	500 A	
材 質	弁箱	FC相当
	弁体	FCD相当
	弁棒	SUS相当
数 量	4 台	
電 動 機	0.2 kW、3 相、AC 400 V、50 Hz	

(5) 気水洗浄装置

本装置は、上向流式生物接触ろ過池の接触層の洗浄を効果的に実施するために設ける材上面近くまで水抜き、及び空気洗浄・気水洗浄を確実に行うものとする。

① 中間水抜弁

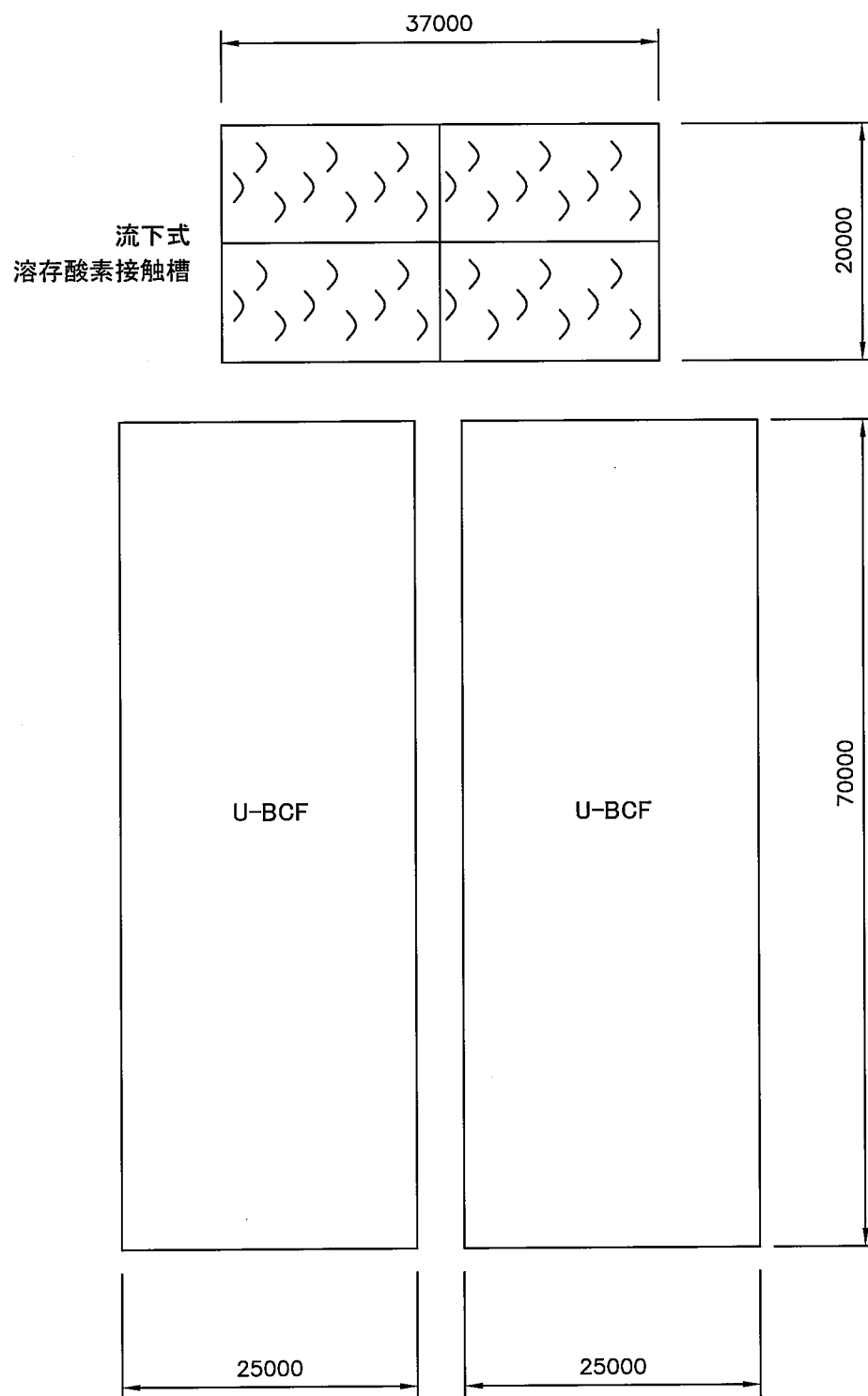
型 式	電動バタフライ弁（フランジレス）		
口 径	300 A		
材 質	弁箱	FC相当	
	弁体	SUS相当	
	弁棒	SUS相当	
数 量	4 台		
電 動 機	0.2 kW 、 3 相 、 AC 400 V、50 Hz		
付 属 品	開・閉リミットスイッチ		1 式

② 池内水抜ラテラル管 300 A SUS304 1 組/池

③ 中間水抜管及び手動弁類 300 A SUS304 1 式

(6) その他付属品

(1) 排 水 弁	電動バタフライ弁（フランジレス）	1 式
(2) 排水切替弁	電動バタフライ弁（フランジレス）	1 式
(3) 手動バタフライ弁		1 式
(4) 仕 切 弁		1 式
(5) 逆 止 弁		1 式
(6) 防振継手		1 式
(7) 散 水 栓		1 式
(8) その他小口径弁類		1 式



【 U-BCF 概略図 】

添付資料－ 3

- ・ 水質データ

TREATED EFFECTIVENESS OF BCF PILOT AT HOA PHU INTAKE STATION

Measurement month :

02/2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)		0			
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	DO (mg/L)	2.97	2.48		1.16	
	Color-filter 0.45 μ m (degree)	20.3	15.5	-24%	16.8	-17%
	Turbidity (NTU)	20.7	15.2	-27%	17.9	-13%
	CODMn (mg/L)	2.11	1.68	-20%	1.86	-12%
	E260	0.430	0.321	-25%	0.372	-13%
	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	0.05	-36%	0.06	-23%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.003	-40%	0.004	-20%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.317	0.433	37%	0.350	10%
	Dissolved-manganese(d-Mn) (mg/L)	0.020	0.012	-40%	0.013	-35%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date :

08/02/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		7/2 9:00		7/2 9:30	
	Sampling date and time	11:00	8/2 11:05		8/2 11:10	
	Filtration time after washing finished (h)		26 h		26 h	
BASIC	Water temperature (°C)	28.2	28.5		28.7	
	pH	6.10	6.30		6.20	
	DO (mg/L)	3.03	5.45		5.16	
	Conductivity (μ S/cm)	94	98		95	
	Color-filter 0.45 μ m (degree)	28.0	16.0	-43%	16.0	-43%
	Turbidity (NTU)	25.0	18.4	-26%	19.5	-22%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.25	1.60	-29%	1.75	-22%
	E260					
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.12	0.08	-33%	0.11	-8%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.004	-20%	0.004	-20%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.4	0.5	25%	0.4	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.014	0.011	-21%	0.012	-14%
	Dissolved-iron(d-Fe) (mg/L)	0.28	0.19	-32%	0.22	-21%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 10/02/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		09/2 9:00		9/2 9:00	
	Sampling date and time	11:00	10/2 11:05		10/2 11:10	
	Filtration time after washing finished (h)		26 h		26 h	
BASIC	Water temperature (°C)	27.1	27.0		27.2	
	pH	6.30	6.47		6.28	
	DO (mg/L)	3.15	4.67		3.65	
	Conductivity (μ S/cm)	84.4	88.7		87.3	
	Color-filter 0.45 μ m (degree)	26.0	22.0	-15%	24.0	-8%
	Turbidity (NTU)	22.0	20.4	-7%	21.0	-5%
ORGANIC COMPOUND S	CODMn (mg/L)	2.05	1.70	-17%	1.85	-10%
	E260					
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.13	0.09	-31%	0.10	-23%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.004	-20%	0.005	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.4	33%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.015	0.009	-40%	0.011	-27%
	Dissolved-iron(d-Fe) (mg/L)	0.30	0.23	-23%	0.28	-7%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Measurement date :

13/02/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		13/2 10:30		13/2 10:30	
	Sampling date and time	13:00	13/2 13:05		13/2 13:10	
	Filtration time after washing finished (h)		2,5h		2,5h	
BASIC	Water temperature (°C)	30.1	30.1		30.4	
	pH	6.31	6.69		6.51	
	DO (mg/L)	3.85	1.28		1.45	
	Conductivity (μ S/cm)	104	144		110	
	Color-filter 0.45 μ m (degree)	20.0	16.0	-20%	19.0	-5%
	Turbidity (NTU)	23.6	20.3	-14%	21.6	-8%
ORGANIC COMPOUNDS	CODMn (mg/L)	1.90	1.55	-18%	1.80	-5%
	E260	0.473	0.416	-12%	0.412	-13%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.05	0.04	-20%	0.04	-20%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.003	0.003	0%	0.003	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.4	33%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.024	0.009	-63%	0.011	-54%
	Dissolved-iron(d-Fe) (mg/L)	0.20	0.14	-30%	0.19	-5%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 18/02/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		17/2 12:00		17/2 12:00	
	Sampling date and time	10:40	18/2 10:45		18/2 10:50	
	Filtration time after washing finished (h)		22h15		22h10	
BASIC	Water temperature (°C)	26.5	26.8		26.4	
	pH	6.30	6.40		6.20	
	DO (mg/L)	2.48	1.16		1.20	
	Conductivity (μ S/cm)	373	386		358	
	Color-filter 0.45 μ m (degree)	14.0	12.0	-14%	13.0	-7%
	Turbidity (NTU)	14.6	12.3	-16%	12.4	-15%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.05	1.75	-15%	1.85	-10%
	E260	0.308	0.217	-30%	0.248	-19%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.05	0.03	-40%	0.03	-40%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.01	0.003	-40%	0.003	-40%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.30	0.50	67%	0.50	67%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.024	0.019	-21%	0.021	-13%
	Dissolved-iron(d-Fe) (mg/L)	0.11	0.08	-27%	0.09	-18%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 25/02/2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		25/2 11:00		25/2 11:00	
	Sampling date and time	14:00	25/2 14:05		2/2 14:10	
	Filtration time after washing finished (h)		3h		3h	
BASIC	Water temperature (°C)	30.5	30.2		30.2	
	pH	6.17	6.56		6.48	
	DO (mg/L)	2.86	1.21		1.89	
	Conductivity (μ S/cm)	43	44		56	
	Color-filter 0.45 μ m (degree)	16.0	12.0	-25%	13.0	-19%
	Turbidity (NTU)	18.2	14.1	-23%	15.6	-14%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.30	1.85	-20%	2.05	-11%
	E260	0.485	0.304	-37%	0.445	-8%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.06	0.03	-50%	0.04	-33%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.003	-25%	0.004	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.4	33%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.019	0.009	-53%	0.011	-42%
	Dissolved-iron(d-Fe) (mg/L)	0.19	0.18	-5%	0.19	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Measurement date :

26/02/2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		25/2 11:00		25/2 11:00	
	Sampling date and time	09:00	26/2 09:05		26/2 09:10	
	Filtration time after washing finished (h)		22h		22h	
BASIC	Water temperature (°C)	29.0	29.2		29.2	
	pH	6.19	6.63		6.35	
	DO (mg/L)	2.45	1.12		1.16	
	Conductivity (μ S/cm)	78	83		89	
	Color-filter 0.45 μ m (degree)	18.0	15.0	-17%	16.0	-11%
	Turbidity (NTU)	20.5	17.1	-17%	17.4	-15%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.10	1.75	-17%	1.85	-12%
	E260	0.469	0.347	-26%	0.383	-18%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.06	0.04	-33%	0.04	-33%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.003	-25%	0.004	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.4	33%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.025	0.012	-52%	0.014	-44%
	Dissolved-iron(d-Fe) (mg/L)	0.20	0.19	-5%	0.19	-5%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date :

05/3/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		05/3 9:00		5/3 9:00	
	Sampling date and time	11:00	05/3 11:05		05/3 11:10	
	Filtration time after washing finished (h)		2,0 h		2,0 h	
BASIC	Water temperature (°C)	30.4	30.1		30.2	
	pH	6.20	6.30		6.24	
	DO (mg/L)	2.20	1.06		1.10	
	Conductivity (μ S/cm)	145	139		130	
	Color-filter 0.45 μ m (degree)	24.0	20.0	-17%	21.0	-13%
	Turbidity (NTU)	20.4	18.0	-12%	19.2	-6%
ORGANIC COMPOUNDS	CODMn (mg/L)	1.80	1.40	-22%	1.50	-17%
	E260	0.189	0.150	-21%	0.163	-14%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.05	0.03	-40%	0.03	-40%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.001	0.002	100%	0.002	100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.3	0%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.024	0.016	-33%	0.018	-25%
	Dissolved-iron(d-Fe) (mg/L)	0.19	0.16	-16%	0.17	-11%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 10/3/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		09/3 9:00		9/3 9:00	
	Sampling date and time	11:00	10/3 11:05		10/3 11:10	
	Filtration time after washing finished (h)		26 h		26 h	
BASIC	Water temperature (°C)	30.4	30.1		30.2	
	pH	6.20	6.12		6.14	
	DO (mg/L)	1.81	0.82		0.80	
	Conductivity (μ S/cm)	123	113		112	
	Color-filter 0.45 μ m (degree)	27.0	19.0	-30%	20.0	-26%
	Turbidity (NTU)	13.4	11.5	-14%	11.5	-14%
ORGANIC COMPOUNDS	CODMn (mg/L)	1.60	1.10	-31%	1.30	-19%
	E260	0.113	0.045	-60%	0.055	-51%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.02	<0.02	-100%	<0.02	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.001	0.002	100%	0.002	100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.2	0.2	0%	0.2	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.016	0.010	-38%	0.011	-31%
	Dissolved-iron(d-Fe) (mg/L)	0.16	0.15	-6%	0.15	-6%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Measurement date : 18/03/ 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		17/3 10:00		17/3 10:00	
	Sampling date and time	10:00	18/3 10:05		18/3 10:10	
	Filtration time after washing finished (h)		24h		24h	
BASIC	Water temperature (°C)	29.0	28.9		29.1	
	pH	6.10	5.82		5.86	
	DO (mg/L)	1.55	0.65		1.10	
	Conductivity (μ S/cm)	123	113		112	
	Color-filter 0.45 μ m (degree)	27.0	19.0	-30%	20.0	-26%
	Turbidity (NTU)	14.8	12.5	-16%	13.0	-12%
ORGANIC COMPOUNDS	CODMn (mg/L)	1.90	1.40	-26%	1.60	-16%
	E260	0.113	0.088	-22%	0.108	-4%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	<0.02	-100%	0.02	-75%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.002	0.003	50%	0.003	50%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.3	0%	0.3	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.066	0.034	-48%	0.034	-48%
	Dissolved-iron(d-Fe) (mg/L)	0.05	0.04	-20%	0.05	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Measurement date : 28/3/2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		27/3 9:00		27/3 9:00	
	Sampling date and time	10:00	28/3 10:05		28/3 10:10	
	Filtration time after washing finished (h)		25h		25h	
BASIC	Water temperature (°C)	29.4	29.6		29.5	
	pH	6.06	6.17		6.32	
	DO (mg/L)	0.88	0.73		1.05	
	Conductivity (μ S/cm)	141	145		146	
	Color-filter 0.45 μ m (degree)	25.0	23.0	-8%	23.0	-8%
	Turbidity (NTU)	12.3	10.6	-14%	10.9	-11%
ORGANIC COMPOUNDS	CODMn (mg/L)	1.45	1.30	-10%	1.35	-7%
	E260	0.232	0.225	-3%	0.229	-1%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	0.06	-25%	0.07	-13%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.003	0.002	-33%	0.002	-33%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.2	0.2	0%	0.2	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.008	0.007	-13%	0.007	-13%
	Dissolved-iron(d-Fe) (mg/L)	0.06	0.05	-17%	0.06	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 03 / 04 / 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		02/04/2014 10:00		02/04/2014 10:00	
	Sampling date and time	10h20	03/04/2014 10:20		03/04/2014 10:20	
	Filtration time after washing finished (h)		24h20		24h20	
BASIC	Water temperature (°C)	31.0	31.5		32.0	
	pH	6.33	6.34		6.21	
	DO (mg/L)	3.43	6.50		5.39	
	Conductivity (μ S/cm)	301	299		301	
	Color-filter 0.45 μ m (degree)	18.00	14.0	-22%	16.0	-11%
	Turbidity (NTU)	9.10	7.0	-23%	8.0	-12%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.60	2.30	-12%	1.70	-35%
	E260	0.14	0.138	-3%	0.036	-75%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.19	0.14	-29%	0.19	1%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.01	<0.002	-100%	<0.002	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.80	0.200	-75%	0.020	-98%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.08	0.053	-32%	0.033	-58%
	Dissolved-iron(d-Fe) (mg/L)	0.22	0.24	9%	0.13	-41%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 10 / 04 / 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.1		1	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		08/04 10:00		08/04 10:00	
	Sampling date and time	10/4 08:49	10/4 08:49		10/4 08:49	
	Filtration time after washing finished (h)		46h49		46h49	
BASIC	Water temperature (°C)	31.0	32.0		32.0	
	pH	6.43	6.61		6.60	
	DO (mg/L)	0.93	0.80		0.77	
	Conductivity (μ S/cm)	100	98		98	
	Color-filter 0.45 μ m (degree)	199.00	112.0	-44%	104.0	-48%
	Turbidity (NTU)	19.50	11.0	-44%	11.0	-44%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.70	2.70	0%	2.20	-19%
	E260	0.16	0.138	-12%	0.105	-33%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.21	0.15	-29%	0.23	10%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.00	<0.002	#DIV/0!	0.014	#DIV/0!
	Nitrate-nitrogen(N-NO3) (mg/L)	0.60	0.500	-17%	0.500	-17%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.11	0.042	-63%	0.045	-61%
	Dissolved-iron(d-Fe) (mg/L)	0.19	0.19	0%	0.13	-32%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 24 / 04 / 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1		0.95	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		22/04 10:00		22/04 10:00	
	Sampling date and time	24/4 09:40	24/4 09:40		24/4 09:40	
	Filtration time after washing finished (h)		47h40		47h40	
BASIC	Water temperature (°C)	32.000	34.000		34.00	
	pH	6.990	7.180		6.72	
	DO (mg/L)	0.3*	0.7*		0.9*	
	Conductivity (μ S/cm)	137.200	127.400		127.40	
	Color-filter 0.45 μ m (degree)	162.000	90.000	-44%	92.00	-43%
	Turbidity (NTU)	24.700	12.700	-49%	14.00	-43%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.000	3.500	-13%	3.00	-25%
	E260	0.300	0.192	-36%	0.21	-29%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.420	0.380	-10%	0.27	-36%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.001	0.005	400%	0.002	100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.500	0.400	-20%	2.40	380%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.079	0.079	0%	0.055	-30%
	Dissolved-iron(d-Fe) (mg/L)	0.240	0.240	0%	0.21	-13%

Note: * DO results: We are taking other samples to check result again.

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 08 / 05 / 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1		0.95	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		06/05 10:00		06/05 10:00	
	Sampling date and time	08/05 09:40	08/05 09:30		08/05 09:40	
	Filtration time after washing finished (h)		47h30		47h30	
BASIC	Water temperature (°C)	31.500	34.000		34.000	
	pH	6.460	6.860		6.630	
	DO (mg/L)*	0.900	0.600		0.700	
	Conductivity (μ S/cm)	120.000	115.000		115.000	
	Color-filter 0.45 μ m (degree)	23.000	17.000	-26%	17.000	-26%
	Turbidity (NTU)	9.210	6.630	-28%	6.210	-33%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.400	2.300	-4%	2.200	-8%
	E260	0.286	0.196	-31%	0.226	-21%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.418	0.344	-18%	0.362	-13%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.007	74%	0.005	26%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.800	0.600	-25%	0.400	-50%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.056	0.080	43%	0.079	41%
	Dissolved-iron(d-Fe) (mg/L)	0.180	0.180	0%	0.180	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

Mesurement date : 15 / 05 / 2014

Sampling place		Raw water	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		0.9		0.88	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		14/05 10:00		14/05 10:00	
	Sampling date and time	15/05 10:15	15/05 10:15		15/05 10:15	
	Filtration time after washing finished (h)		24h15		24h15	
BASIC	Water temperature (°C)	32.000	32.000		32.000	
	pH	6.640	6.560		6.620	
	DO (mg/L)*	0.500	0.600		0.600	
	Conductivity (μ S/cm)	750.000	254.000		228.000	
	Color-filter 0.45 μ m (degree)	21.000	18.000	-14%	17.000	-19%
	Turbidity (NTU)	14.000	8.300	-41%	8.100	-42%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.100	2.100	-32%	2.300	-26%
	E260	0.238	0.202	-15%	0.169	-29%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.544	0.416	-24%	0.657	21%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.011	175%	0.006	50%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.200	0.300	50%	0.500	150%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.088	0.090	2%	0.085	-3%
	Dissolved-iron(d-Fe) (mg/L)	0.130	0.120	-8%	0.130	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Mesurement date : 05 / 06 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1.00	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		03/06 10:00		03/06 10:00	
	Sampling date and time	05/06 10:00	05/06 08:30		05/06 08:30	
	Filtration time after washing finished (h)		46h		46h	
BASIC	Water temperature (°C)	32.000	33.000		33.000	
	pH	6.740	7.110		6.830	
	DO (mg/L)	4.500	0.500		0.700	
	Conductivity (μ S/cm)	114.600	119.500		120.600	
	Color-filter 0.45 μ m (degree)	23.000	20.000	-13%	15.000	-35%
	Turbidity (NTU)	18.000	9.000	-50%	7.000	-61%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.100	1.400	-33%	0.900	-57%
	E260	0.127	0.071	-44%	0.083	-35%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.300	0.074	-75%	0.060	-80%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.004	-20%	0.001	-80%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.500	0.800	60%	0.700	40%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.030	0.011	-63%	0.006	-80%
	Dissolved-iron(d-Fe) (mg/L)	0.210	0.190	-10%	0.150	-29%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 12 / 06 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1.00	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		11/06 10:00		11/06 10:00	
	Sampling date and time	12/06 10:00	12/06 10:00		12/06 10:00	
	Filtration time after washing finished (h)		24h		24h	
BASIC	Water temperature (°C)	32.000	34.000		34.000	
	pH	6.720	6.970		6.600	
	DO (mg/L)	2.500	0.600		0.700	
	Conductivity (μ S/cm)	186.800	199.700		203.000	
	Color-filter 0.45 μ m (degree)	26.000	19.000	-27%	18.000	-31%
	Turbidity (NTU)	16.900	11.000	-35%	9.500	-44%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.600	2.100	-42%	2.000	-44%
	E260	0.100	0.058	-42%	0.064	-36%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.047	0.000	-100%	0.000	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.075	0.004	-95%	0.014	-82%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.500	0.600	20%	0.500	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.058	0.013	-78%	0.008	-86%
	Dissolved-iron(d-Fe) (mg/L)	0.140	0.140	0%	0.120	-14%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 19 / 06 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1.00	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		17/06 09:00		17/06 09:00	
	Sampling date and time	19/06 09:50	19/06 09:50		19/06 09:50	
	Filtration time after washing finished (h)		48h50		48h50	
BASIC	Water temperature (°C)	31.000	32.000		32.000	
	pH	6.450	6.630		6.580	
	DO (mg/L)	3.600	0.500		0.200	
	Conductivity (μ S/cm)	133.400	131.600		129.100	
	Color-filter 0.45 μ m (degree)	27.000	20.000	-26%	17.000	-37%
	Turbidity (NTU)	21.900	19.100	-13%	15.700	-28%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.200	2.200	-31%	2.400	-25%
	E260	0.113	0.087	-23%	0.074	-35%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.190	0.110	-42%	0.100	-47%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.004	-20%	0.005	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	1.000	1.000	0%	0.900	-10%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.039	0.018	-54%	0.007	-82%
	Dissolved-iron(d-Fe) (mg/L)	0.170	0.180	6%	0.170	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 26 / 06 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1.00	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		25/06 09:00		25/06 09:00	
	Sampling date and time	26/06 13:35	26/06 13:35		26/06 13:35	
	Filtration time after washing finished (h)		28h35		28h35	
BASIC	Water temperature (°C)	30.600	32.700		32.600	
	pH	6.630	6.540		6.530	
	DO (mg/L)	4.730	0.930		0.550	
	Conductivity (μ S/cm)	114.400	113.400		113.700	
	Color-filter 0.45 μ m (degree)	33.000	30.000	-9%	27.000	-18%
	Turbidity (NTU)	41.000	16.000	-61%	13.900	-66%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.400	1.900	-44%	2.000	-41%
	E260	0.149	0.099	-34%	0.080	-46%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.400	0.160	-60%	0.130	-68%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.007	0.006	-14%	0.021	200%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.900	1.200	33%	1.300	44%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.048	0.021	-56%	0.015	-69%
	Dissolved-iron(d-Fe) (mg/L)	0.210	0.200	-5%	0.210	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 03 / 07 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)		1.5		1.00	
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		03/07 08:30		03/07 08:30	
	Sampling date and time	03/07 11:00	03/07 11:00		03/07 11:00	
	Filtration time after washing finished (h)		2h30		2h30	
BASIC	Water temperature (°C)	31.000	32.000		32.600	
	pH	6.710	6.680		6.340	
	DO (mg/L)	4.100	0.4/0.6		0.900	
	Conductivity (μ S/cm)	172.200	165.400		165.500	
	Color-filter 0.45 μ m (degree)	35.000	25.000	-29%	24.000	-31%
	Turbidity (NTU)	33.000	39.000	18%	28.000	-15%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.900	2.600	-10%	2.000	-31%
	E260	0.125	0.079	-37%	0.058	-54%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.690	0.170	-75%	0.140	-80%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.010	0.008	-24%	0.007	-33%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.600	1.000	67%	1.100	83%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.081	0.037	-54%	0.033	-59%
	Dissolved-iron(d-Fe) (mg/L)	0.210	0.180	-14%	0.170	-19%
COD Cr		15.200	12.400	-18%	9.700	-36%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 10 / 07 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)					
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		09/07 10:00		09/07 10:00	
	Sampling date and time	10/07 10:45	10/07 10:45		10/07 10:45	
	Filtration time after washing finished (h)		24h40		24h45	
BASIC	Water temperature (°C)	29.5000	30.0000		30.0000	
	pH	6.0000	6.4900		6.0200	
	DO (mg/L)	3.5000	0.2000		0.5000	
	Conductivity (μ S/cm)	78.0000	87.4000		79.4000	
	Color-filter 0.45 μ m (degree)	50.0000	38.0000	-24%	37.0000	-26%
	Turbidity (NTU)	66.5000	65.2000	-2%	76.8000	15%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.8000	2.9000	-24%	3.5000	-8%
	E260	0.4200	0.4290	2%	0.4140	-1%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.4190	0.2330	-44%	0.2180	-48%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0063	0.0042	-33%	0.0064	2%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7000	0.9000	29%	0.9000	29%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.0710	0.0280	-61%	0.0300	-58%
	Dissolved-iron(d-Fe) (mg/L)	0.1800	0.1700	-6%	0.1500	-17%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 17 / 07 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)					
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		16/07 10:00		16/07 10:00	
	Sampling date and time	17/07 10:00	17/07 10:00		17/07 10:00	
	Filtration time after washing finished (h)		24h00		24h00	
BASIC	Water temperature (°C)	29.8000	30.0000		30.0000	
	pH	5.7600	6.1700		5.9100	
	DO (mg/L)	3.6000	0.6000		1.0000	
	Conductivity (μ S/cm)	50.6000	41.9000		48.0000	
	Color-filter 0.45 μ m (degree)	26.0000	24.0000	-8%	22.0000	-15%
	Turbidity (NTU)	33.8000	41.1000	22%	43.0000	27%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.7000	3.3000	-11%	3.2000	-14%
	E260	0.3480	0.2840	-18%	0.2520	-28%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.1600	0.1680	5%	0.1180	-26%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0053	0.0051	-4%	0.0067	26%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8000	1.2000	50%	0.8000	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.0720	0.0400	-44%	0.0480	-33%
	Dissolved-iron(d-Fe) (mg/L)	0.1700	0.1500	-12%	0.1500	-12%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 23 / 07 / 2014

Sampling place		Raw water after air supply	Pre-sedimentation Basin			
			Treated water by NO.A BCF		Treated water by NO.B BCF	
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)					
	Activated Carbon Layer height (m)					
	Treatment volume(L/min)		2		2	
	Running start date and time after washing finished		22/07 10:00		22/07 10:00	
	Sampling date and time	23/07 10:00	23/07 10:00		23/07 10:00	
	Filtration time after washing finished (h)		24h00		24h00	
BASIC	Water temperature (°C)	28.0000	29.0000		29.0000	
	pH	6.0200	6.5400		6.0400	
	DO (mg/L)	4.1000	0.4000		0.5000	
	Conductivity (μ S/cm)	65.5000	90.3000		66.1000	
	Color-filter 0.45 μ m (degree)	49.0000	45.0000	-8%	41.0000	-16%
	Turbidity (NTU)	138.0000	67.5000	-51%	123.0000	-11%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.4000	3.3000	-25%	3.8000	-14%
	E260	0.4200	0.4190	0%	0.4520	8%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.3300	0.1900	-42%	0.1600	-52%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0072	0.0258	258%	0.0051	-29%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.9000	1.1000	22%	1.0000	11%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.0560	0.0250	-55%	0.0300	-46%
	Dissolved-iron(d-Fe) (mg/L)	0.1700	0.2300	35%	0.2000	18%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 29 / 07 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)			1.02			1.48			
	Treatment volume(L/min)			2			2			
	Running start date and time after washing finished			28/07 10:00			28/07 10:00			
	Sampling date and time		29/07 09:30	29/07 09:30			29/07 09:30			
	Filtration time after washing finished (h)			23h30		A/raw	23h30		B/raw	
BASIC	Water temperature (°C)		30.0000	32.0000			32.0000			
	pH	6.23	6.3900	6.5900			6.0900			
	DO (mg/L)	1.7	5.4000	2.0000			1.5000			
	Conductivity (μ S/cm)	77	77.1000	71.5000			73.8000			
	Color-filter 0.45 μ m (degree)	32	30.0000	43.0000	43%	34%	33.0000	10%	3%	
	Turbidity (NTU)	56	110.0000	46.0000	-58%	-18%	47.2000	-57%	-16%	
ORGANIC COMPOUNDS	CODMn (mg/L)	3	5.2000	3.2000	-38%	7%	2.7000	-48%	-10%	
	E260	0.429	0.4340	0.0550	-87%	-87%	0.3970	-9%	-7%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.438	0.4450	0.1000	-78%	-77%	0.1980	-56%	-55%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0071	0.0063	0.0082	30%	15%	0.0039	-38%	-45%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.9000	1.0000	11%	25%	1.0000	11%	25%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.06	0.0530	0.0300	-43%	-50%	0.0370	-30%	-38%	
	Dissolved-iron(d-Fe) (mg/L)	0.21	0.1900	0.2100	11%	0%	0.2000	5%	-5%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 07 / 08 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.49			1.06		
	Treatment volume(L/min)			2			2		
	Running start date and time after washing finished			05/08 10:00			05/08 10:00		
	Sampling date and time		07/08 09:30	07/08 09:30			07/08 09:30		
	Filtration time after washing finished (h)			47h30		A/raw	47h30		B/raw
BASIC	Water temperature (°C)		32.0000	33.0000			32.0000		
	pH	6.47	6.5700	6.6100			6.4900		
	DO (mg/L)	3	5.0000						
	Conductivity (μ S/cm)	208	107.0000	61.0000			50.0000		
	Color-filter 0.45 μ m (degree)	52	54.0000	63.0000	17%	21%	60.0000	11%	15%
	Turbidity (NTU)	42	41.0000	43.0000	5%	2%	41.0000	0%	-2%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.8	2.7000	2.7000	0%	-4%	2.7000	0%	-4%
	E260	0.157	0.1380	0.1210	-12%	-23%	0.1790	30%	14%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.2	0.2000	0.1900	-5%	-5%	0.2000	0%	0%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0073	0.0067	0.0045	-33%	-38%	0.0055	-18%	-25%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.4	0.7000	0.8000	14%	100%	0.7000	0%	75%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.0120	0.0100	-17%	-17%	0.0090	-25%	-25%
	Dissolved-iron(d-Fe) (mg/L)	0.24	0.2300	0.3000	30%	25%	0.3100	35%	29%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 14 / 08 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.49			1.06		
	Treatment volume(L/min)			2			2		
	Running start date and time after washing finished			13/08 10:00			13/08 10:00		
	Sampling date and time		14/08 09:00	14/08 09:00			14/08 09:00		
	Filtration time after washing finished (h)			23h00		A/raw	23h00		B/raw
BASIC	Water temperature (°C)		30.0000	32.0000			32.0000		
	pH	6.69	6.6700	6.7700			6.6100		
	DO (mg/L)	3.2	4.1000	0.9000			1.2000		
	Conductivity (μ S/cm)	53	52.1000	49.4000			52.5000		
	Color-filter 0.45 μ m (degree)	54	56.0000	64.0000	14%	19%	63.0000	13%	17%
	Turbidity (NTU)	47.7	46.5000	49.2000	6%	3%	52.1000	12%	9%
ORGANIC COMPOUNDS	CODMn (mg/L)	3	2.8000	2.6000	-7%	-13%	2.7000	-4%	-10%
	E260	0.443	0.4690	0.4440	-5%	0%	0.4590	-2%	4%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.13	0.1400	0.1300	-7%	0%	0.1100	-21%	-15%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0039	0.0044	0.0029	-34%	-26%	0.0034	-23%	-13%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.5000	0.7000	40%	0%	0.6000	20%	-14%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.016	0.0220	0.0140	-36%	-13%	0.0170	-23%	6%
	Dissolved-iron(d-Fe) (mg/L)	0.3	0.3100	0.3600	16%	20%	0.3300	6%	10%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 21 / 08 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.5			1.00		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			21/08 07:50			21/08 07:50		
	Sampling date and time		21/08 10:00	21/08 10:00			21/08 10:00		
	Filtration time after washing finished (h)			2h10		A/raw	2h10		B/raw
BASIC	Water temperature (°C)		31.0000	32.0000			32.0000		
	pH	6.67	6.5400	6.8600			6.5400		
	DO (mg/L)	3.2	4.2	0.5			1.6		
	Conductivity (μ S/cm)	132.3	122.5000	56.2000			63.0000		
	Color-filter 0.45 μ m (degree)	51	53.0000	52.0000	-2%	2%	58.0000	9%	14%
	Turbidity (NTU)	34	33.0000	30.0000	-9%	-12%	30.0000	-9%	-12%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.1	2.5000	1.8000	-28%	-14%	2.0000	-20%	-5%
	E260	0.467	0.3630	0.3360	-7%	-28%	0.3010	-17%	-36%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.235	0.2160	0.1700	-21%	-28%	0.1850	-14%	-21%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0054	0.0055	0.0058	5%	7%	0.0032	-42%	-41%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.5000	0.7000	40%	40%	0.7000	40%	40%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.019	0.0150	0.0130	-13%	-32%	0.0130	-13%	-32%
	Dissolved-iron(d-Fe) (mg/L)	0.31	0.2900	0.3300	14%	6%	0.3100	7%	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 27 / 08 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.45			1.04		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			27/08 09:30			27/08 09:30		
	Sampling date and time		27/08 11:45	27/08 11:45			27/08 11:45		
	Filteration time after washing finished (h)			2h15		A/raw	2h15		B/raw
BASIC	Water temperature (°C)		30.0000	30.0000			30.0000		
	pH	6.42	6.3700	6.5800			6.3600		
	DO (mg/L)	0.6	2.1/2.2	0.1			0.3000		
	Conductivity (μ S/cm)	68	62.0000	63.0000			61.0000		
	Color-filter 0.45 μ m (degree)	45	45.0000	56.0000	24%	24%	53.0000	18%	
	Turbidity (NTU)	81	73.0000	70.0000	-4%	-14%	68.0000	-7%	
ORGANIC COMPOUNDS	CODMn (mg/L)	3.8	2.9000	2.4000	-17%	-37%	2.3000	-21%	-39%
	E260	0.42	0.4270	0.4450	4%	6%	0.4640	9%	10%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.39	0.3600	0.2100	-42%	-46%	0.2200	-39%	-44%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.0080	0.0050	-38%	-17%	0.0050	-38%	-17%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.8000	1.1000	38%	38%	1.1000	38%	38%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.036	0.0410	0.0210	-49%	-42%	0.0160	-61%	-56%
	Dissolved-iron(d-Fe) (mg/L)	0.19	0.2100	0.2400	14%	26%	0.2300	10%	21%
COD Cr									

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (Replay)

Measurement date : 11 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.45			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			11/09 08:15			11/09 08:30		
	Sampling date and time		11/09 10:35	11/09 10:35			11/09 10:35		
	Filtration time after washing finished (h)			2h20		A/raw	2h20		B/raw
BASIC	Water temperature (°C)		31.0000	31.0000			31.0000		
	pH	6.45	6.5200	6.5900			6.4300		
	DO (mg/L)	0.7	5/5.4	0.9			1.7000		
	Conductivity (μ S/cm)	71.9	78.4000	64.7000			65.7000		
	Color-filter 0.45 μ m (degree)	42	51.0000	43.0000	-16%	2%	45.0000	-12%	7%
	Turbidity (NTU)	73.1	73.0000	63.0000	-14%	-14%	65.0000	-11%	-11%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.4	3.4000	2.7000	-21%	-21%	2.8000	-18%	-18%
	E260	0.483	0.4830	0.4670	-3%	-3%	0.4280	-11%	-11%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.4	0.4100	0.2200	-46%	-45%	0.2400	-41%	-40%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0064	0.0083	0.0030	-64%	-53%	0.0038	-54%	-41%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.7000	1.1000	57%	38%	0.9000	29%	13%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.036	0.0410	0.0170	-59%	-53%	0.0140	-66%	-61%
	Dissolved-iron(d-Fe) (mg/L)	0.21	0.2400	0.2200	-8%	5%	0.2200	-8%	5%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (Enhance)

Measurement date : 15 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.45			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			15/09 08:30			15/09 08:30		
	Sampling date and time		15/09 14:30	15/09 14:30			15/09 14:30		
	Filteration time after washing finished (h)			6h00		A/raw	6h00		B/raw
BASIC	Water temperature (°C)		29.2000	29.2000			29.2000		
	pH	6.04	6.5100	6.5400			6.3400		
	DO (mg/L)	2.56	7.4800	4.48			5.0700		
	Conductivity (μ S/cm)	58.8	59.0000	56.5000			57.1000		
	Color-filter 0.45 μ m (degree)	36	31.0000	19.0000	-39%	-47%	22.0000	-29%	
	Turbidity (NTU)	72	71.0000	68.0000	-4%	-6%	64.0000	-10%	
ORGANIC COMPOUNDS	CODMn (mg/L)	3.9	4.0000	2.7000	-33%	-31%	3.0000	-25%	-23%
	E260	0.56	0.5350	0.5730	7%	2%	0.5610	5%	0%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	0.0600	0.0400	-33%	-50%	0.0500	-17%	-38%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.001	0.0020	0.0010	-50%	0%	0.0020	0%	100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.7000	0.7000	0%	0%	0.8000	14%	14%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.041	0.0340	0.0210	-38%	-49%	0.0140	-59%	-66%
	Dissolved-iron(d-Fe) (mg/L)	0.17	0.1700	0.1700	0%	0%	0.2000	18%	18%
COD Cr		16	15.4000	12.6000	-18%	-21%	12.4000	-19%	-23%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (Enhance)

Measurement date : 17 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.45			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			17/09 08:30			17/09 08:30		
	Sampling date and time		17/09 11:30	17/09 11:30			17/09 11:30		
	Filteration time after washing finished (h)			3h00		A/raw	3h00		B/raw
BASIC	Water temperature (°C)	30.9	30.9000	30.7000			30.6000		
	pH	6.26	6.5900	6.6200			6.6400		
	DO (mg/L)	2.78	7.4000	3.04			4.0400		
	Conductivity (μ S/cm)	65.7	65.2000	64.7000			60.5000		
	Color-filter 0.45 μ m (degree)	30	26.0000	22.0000	-15%	-27%	19.0000	-27%	-37%
	Turbidity (NTU)	38	39.1000	34.6000	-12%	-9%	34.9000	-11%	-8%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.9	4.1000	2.9000	-29%	-26%	2.9000	-29%	-26%
	E260	0.72	0.7100	0.6490	-9%	-10%	0.6540	-8%	-9%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.16	0.1400	0.0800	-43%	-50%	0.0900	-36%	-44%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.0050	0.0040	-20%	-20%	0.0040	-20%	-20%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.9	0.6000	1.1000	83%	22%	1.0000	67%	11%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.038	0.0360	0.0180	-50%	-53%	0.0150	-58%	-61%
	Dissolved-iron(d-Fe) (mg/L)	0.25	0.2500	0.2400	-4%	-4%	0.2400	-4%	-4%
COD Cr					#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (Enhance)

Measurement date : 19 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.43			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			19/09 09:00			19/09 09:00		
	Sampling date and time		19/09 11:30	19/09 11:30			19/09 11:30		
	Filteration time after washing finished (h)			2h30		A/raw	2h30		B/raw
BASIC	Water temperature (°C)	31.7	31.700	32.400			32.000		
	pH	6.03	6.540	6.740			6.380		
	DO (mg/L)	2.62	7.340	2.980			4.310		
	Conductivity (μ S/cm)	67.4	77.700	72.200			67.100		
	Color-filter 0.45 μ m (degree)	17	22.000	37.000	68%	118%	34.000	55%	100%
	Turbidity (NTU)	38.2	44.100	28.500	-35%	-25%	31.400	-29%	-18%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.6	3.400	4.200	24%	17%	3.600	6%	0%
	E260	0.66	0.716	0.189	-74%	-71%	0.309	-57%	-53%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.09	0.080	0.060	-25%	-33%	0.060	-25%	-33%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.007	0.005	-29%	0%	0.004	-43%	-20%
	Nitrate-nitrogen(N-NO3) (mg/L)	1	1.000	0.900	-10%	-10%	1.000	0%	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.035	0.055	0.015	-73%	-57%	0.014	-75%	-60%
	Dissolved-iron(d-Fe) (mg/L)	0.17	0.250	0.260	4%	53%	0.260	4%	53%
COD Cr		8.1	9.600	7.400	-23%	-9%	6.700	-30%	-17%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 22 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.4			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			22/09 08:30			22/09 08:30		
	Sampling date and time		22/09 11:30	22/09 13:00			22/09 13:00		
	Filteration time after washing finished (h)			4h30		A/raw	4h30		B/raw
BASIC	Water temperature (°C)	32.1	31.900	31.900			32.100		
	pH	6.05	6.420	6.890			6.740		
	DO (mg/L)	2.1	7.370	3.720			3.000		
	Conductivity (μ S/cm)	67.2	66.100	67.600			64.600		
	Color-filter 0.45 μ m (degree)	22	15.000	28.000	87%	27%	27.000	80%	
	Turbidity (NTU)	39.8	50.300	30.900	-39%	-22%	32.900	-35%	
ORGANIC COMPOUNDS	CODMn (mg/L)	3.7	4.700	3.200	-32%	-14%	2.400	-49%	-35%
	E260	0.248	0.255	0.215	-16%	-13%	0.224	-12%	-10%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	0.090	0.050	-44%	-38%	0.050	-44%	-38%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.01	0.008	0.007	-13%	-30%	0.005	-38%	-50%
	Nitrate-nitrogen(N-NO3) (mg/L)	1	0.900	1.000	11%	0%	1.100	22%	10%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.024	0.023	0.002	-91%	-92%	0.002	-91%	-92%
	Dissolved-iron(d-Fe) (mg/L)	0.17	0.160	0.240	50%	41%	0.250	56%	47%
COD Cr		9.1	9.400	7.100	-24%	-22%	6.300	-33%	-31%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 24 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)			1.41			1.04			
	Treatment volume(L/min)			2.0			2			
	Running start date and time after washing finished			22/09 08:30			22/09 08:30			
	Sampling date and time		22/09 11:30	22/09 13:00			22/09 13:00			
	Filtration time after washing finished (h)			4h30		A/raw	4h30			B/raw
BASIC	Water temperature (°C)			32.000			32.000			
	pH	6.75	6.790	6.680			6.580			
	DO (mg/L)	2.45	7.520	3.870			4.660			
	Conductivity (μ S/cm)	51.7	53.900	54.400			50.600			
	Color-filter 0.45 μ m (degree)	15	19.000	20.000	5%	33%	20.000	5%	33%	
	Turbidity (NTU)	35	34.800	28.700	-18%	-18%	28.800	-17%	-18%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4.2	3.900	3.400	-13%	-19%	3.900	0%	-7%	
	E260*	0.058	0.050	0.058	16%	0%	0.058	16%	0%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.276	0.108	0.123	14%	-55%	0.095	-12%	-66%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.002	0.030	0.003	-90%	50%	0.003	-90%	50%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.2	0.500	0.600	20%	200%	0.600	20%	200%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.017	0.014	0.006	-57%	-65%	0.007	-50%	-59%	
	Dissolved-iron(d-Fe) (mg/L)	0.11	0.120	0.130	8%	18%	0.150	25%	36%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 29 / 09 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.41			1.04		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			29/09 08:30			29/09 08:30		
	Sampling date and time		29/09 10:30	29/09 10:30			29/09 10:30		
	Filtration time after washing finished (h)			2h00		A/raw	2h00		B/raw
BASIC	Water temperature (°C)	32	31.400	32.400			31.700		
	pH	6.3	6.830	7.040			6.720		
	DO (mg/L)	2.47	7.340	2.740			4.670		
	Conductivity (μ S/cm)	64.1	62.700	62.600			64.100		
	Color-filter 0.45 μ m (degree)	28	24.000	25.000	4%	-11%	26.000	8%	-7%
	Turbidity (NTU)	20.1	18.500	20.000	8%	0%	14.500	-22%	-28%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.7	3.500	3.300	-6%	-11%	3.800	9%	3%
	E260*	0.271	0.260	0.227	-13%	-16%	0.245	-6%	-10%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.07	0.070	0.050	-29%	-29%	0.050	-29%	-29%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.08	0.060	0.050	-17%	-38%	0.060	0%	-25%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.700	0.700	0%	0%	0.700	0%	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.011	0.007	-36%	-42%	0.007	-36%	-42%
	Dissolved-iron(d-Fe) (mg/L)	0.17	0.180	0.210	17%	24%	0.210	17%	24%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 02 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.4			1.03		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			02/10 09:00			02/10 09:00		
	Sampling date and time		02/10 11:00	02/10 11:00			02/10 11:00		
	Filtration time after washing finished (h)			2h00		A/raw	2h00		B/raw
BASIC	Water temperature (°C)	31.3	31.300	32.100			31.900		
	pH	6.59	6.780	6.800			6.750		
	DO (mg/L)	1.79	7.180	3.270			4.050		
	Conductivity (μ S/cm)	57.8	55.900	54.900			54.600		
	Color-filter 0.45 μ m (degree)	33	38.000	49.000	29%	48%	52.000	37%	58%
	Turbidity (NTU)	41.7	41.000	35.200	-14%	-16%	36.200	-12%	-13%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.8	4.100	2.900	-29%	-24%	3.200	-22%	-16%
	E260*	0.158	0.182	0.181	-1%	15%	0.242	33%	53%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.28	0.220	0.170	-23%	-39%	0.150	-32%	-46%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.004	0.003	-25%	-25%	0.004	0%	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.600	0.700	17%	17%	0.700	17%	17%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.018	0.023	0.014	-39%	-22%	0.014	-39%	-22%
	Dissolved-iron(d-Fe) (mg/L)	0.21	0.240	0.310	29%	48%	0.320	33%	52%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 07 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)			1.38			1.02			
	Treatment volume(L/min)			2.0			2			
	Running start date and time after washing finished			07/10 08:00			07/10 08:00			
	Sampling date and time		07/10 12:30	07/10 12:30			07/10 12:30			
	Filtration time after washing finished (h)			4h30		A/raw	4h30		B/raw	
BASIC	Water temperature (°C)	30.4	30.100	29.500			29.600			
	pH	6.23	6.850	6.860			6.800			
	DO (mg/L)	1.03	7.390	3.260			4.300			
	Conductivity (μ S/cm)	73.6	72.800	69.200			69.500			
	Color-filter 0.45 μ m (degree)	56	56.000	59.000	5%	5%	58.000	4%	4%	
	Turbidity (NTU)	30	32.200	31.800	-1%	6%	31.200	-3%	4%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4.3	4.600	3.400	-26%	-21%	3.700	-20%	-14%	
	E260*	0.199	0.252	0.195	-23%	-2%	0.191	-24%	-4%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.23	0.160	0.050	-69%	-78%	0.060	-63%	-74%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.006	0.005	-17%	-17%	0.005	-17%	-17%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.800	0.800	0%	33%	0.900	13%	50%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.036	0.032	0.013	-59%	-64%	0.010	-69%	-72%	
	Dissolved-iron(d-Fe) (mg/L)	0.13	0.150	0.140	-7%	8%	0.150	0%	15%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 09 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)			1.38			1.02			
	Treatment volume(L/min)			2.0			2			
	Running start date and time after washing finished			09/10 08:30			09/10 08:30			
	Sampling date and time		09/10 10:30	09/10 10:30			09/10 10:30			
	Filteration time after washing finished (h)			2h00		A/raw	2h00		B/raw	
BASIC	Water temperature (°C)		30.700	31.100			30.900			
	pH	6.58	7.020	6.960			6.890			
	DO (mg/L)	0.9	7.280	2.810			3.690			
	Conductivity (μ S/cm)	71.9	73.300	72.500			72.000			
	Color-filter 0.45 μ m (degree)	31	28.000	26.000	-7%	-16%	20.000	-29%		-35%
	Turbidity (NTU)	33	31.200	28.100	-10%	-15%	27.600	-12%		-16%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.2	4.300	3.700	-14%	-12%	3.800	-12%	-10%	
	E260*	0.106	0.088	0.080	-9%	-25%	0.093	6%	-12%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.2	0.160	0.120	-25%	-40%	0.160	0%	-20%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.005	0.006	0.002	-67%	-60%	0.004	-33%	-20%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.700	0.900	29%	29%	0.900	29%	29%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.037	0.019	0.009	-53%	-76%	0.012	-37%	-68%	
	Dissolved-iron(d-Fe) (mg/L)	0.21	0.150	0.160	7%	-24%	0.080	-47%	-62%	
BOD5		4.1	4.200	3.700	-12%	-10%	3.900	-7%	-5%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 14 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.5			1.02		
	Treatment volume(L/min)			2.0			2		
	Running start date and time after washing finished			14/10 09:00			14/10 09:00		
	Sampling date and time		14/10 12:30	14/10 12:30			14/10 12:30		
	Filtration time after washing finished (h)			3h30		A/raw	3h30		B/raw
BASIC	Water temperature (°C)	31.1	31.300	32.000			31.900		
	pH	6.07	6.620	7.060			6.780		
	DO (mg/L)	1.55	7.320	2.710			3.990		
	Conductivity (μ S/cm)	64.1	62.600	71.900			66.800		
	Color-filter 0.45 μ m (degree)	71	72.000	62.000	-14%	-13%	64.000	-11%	-10%
	Turbidity (NTU)	80.9	82.600	70.200	-15%	-13%	63.700	-23%	-21%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.4	4.600	3.700	-20%	-16%	3.800	-17%	-14%
	E260*	0.213	0.189	0.161	-15%	-24%	0.170	-10%	-20%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.14	0.120	0.090	-25%	-36%	0.090	-25%	-36%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.011	0.008	0.006	-25%	-45%	0.007	-13%	-36%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.600	0.700	17%	40%	0.700	17%	40%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.031	0.023	0.013	-43%	-58%	0.012	-48%	-61%
	Dissolved-iron(d-Fe) (mg/L)	0.12	0.130	0.090	-31%	-25%	0.090	-31%	-25%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 16 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.42			1.02		
	Treatment volume(L/min)			2.0			2.0		
	Running start date and time after washing finished			16/10 08:30			16/10 08:30		
	Sampling date and time		16/10 11:20	16/10 11:20			16/10 11:20		
	Filteration time after washing finished (h)			2h50		A/raw	2h50		B/raw
BASIC	Water temperature (°C)	31.2	31.400	31.900			31.900		
	pH	6.3	6.630	6.650			6.620		
	DO (mg/L)	1.45	7.350	3.400			4.050		
	Conductivity (μ S/cm)	52.7	48.800	48.300			54.700		
	Color-filter 0.45 μ m (degree)	39	47.000	42.000	-11%	8%	36.000	-23%	-8%
	Turbidity (NTU)	50.4	46.500	42.500	-9%	-16%	42.800	-8%	-15%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.1	3.900	3.300	-15%	-20%	3.400	-13%	-17%
	E260*	0.188	0.177	0.150	-15%	-20%	0.159	-10%	-15%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.233	0.162	0.084	-48%	-64%	0.076	-53%	-67%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.002	0.004	0.002	-50%	0%	0.003	-25%	50%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.9	1.000	1.100	10%	22%	1.000	0%	11%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.022	0.018	0.009	-50%	-59%	0.008	-56%	-64%
	Dissolved-iron(d-Fe) (mg/L)	0.23	0.260	0.110	-58%	-52%	0.130	-50%	-43%
BOD5		3.2	3.100	2.900	-6%	-9%	3.300	6%	3%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 21 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.4			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			21/10 08:30			21/10 08:30		
	Sampling date and time		21/10 12:30	21/10 12:30			21/10 12:30		
	Filtration time after washing finished (h)			4h00		A/raw	4h00		B/raw
BASIC	Water temperature (°C)	30.9	31.100	31.200			31.700		
	pH	6.17	6.820	6.880			6.780		
	DO (mg/L)	2.25	7.380	3.410			1.640		
	Conductivity (μ S/cm)	45	45.100	46.100			47.300		
	Color-filter 0.45 μ m (degree)	37	33.000	22.000	-33%	-41%	19.000	-42%	-49%
	Turbidity (NTU)	81.6	78.700	66.400	-16%	-19%	55.400	-30%	-32%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.4	4.300	3.400	-21%	-23%	3.500	-19%	-20%
	E260*	0.354	0.321	0.314	-2%	-11%	0.321	0%	-9%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.13	0.100	0.070	-30%	-46%	0.060	-40%	-54%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.008	0.007	0.006	-14%	-25%	0.004	-43%	-50%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.600	0.700	17%	17%	0.700	17%	17%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.009	0.006	-33%	-50%	0.006	-33%	-50%
	Dissolved-iron(d-Fe) (mg/L)	0.06	0.050	0.040	-20%	-33%	0.040	-20%	-33%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply

Measurement date : 23 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.4			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			23/10 09:00			23/10 09:00		
	Sampling date and time		23/10 11:00	23/10 11:00			23/10 11:00		
	Filtration time after washing finished (h)			4h00		A/raw	4h00		B/raw
BASIC	Water temperature (°C)	30.2	30.600	31.000			30.800		
	pH	6.47	6.720	6.590			6.650		
	DO (mg/L)	2.78	7.420	3.730			4.760		
	Conductivity (μ S/cm)	63.4	48.700	53.400			39.600		
	Color-filter 0.45 μ m (degree)	27	26.000	23.000	-12%	-15%	23.000	-12%	-15%
	Turbidity (NTU)	58.2	57.400	49.100	-14%	-16%	50.300	-12%	-14%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.9	4.700	3.700	-21%	-24%	3.800	-19%	-22%
	E260*	0.113	0.186	0.137	-26%	21%	0.122	-34%	8%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.13	0.126	0.120	-5%	-8%	0.094	-25%	-28%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0029	0.0024	0.0026	8%	-10%	0.0029	21%	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.500	0.600	20%	-14%	0.600	20%	-14%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.011	0.007	-36%	-42%	0.009	-18%	-25%
	Dissolved-iron(d-Fe) (mg/L)	0.08	0.080	0.070	-13%	-13%	0.060	-25%	-25%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 28 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.4			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			28/10 08:30			28/10 08:30		
	Sampling date and time		28/10 10:45	28/10 10:45			28/10 10:45		
	Filtration time after washing finished (h)			2h15		A/raw	2h15		B/raw
BASIC	Water temperature (°C)	30.8	31.000	31.500			31.600		
	pH	6.16	6.780	6.680			6.630		
	DO (mg/L)	1.03	7.270	1.950			1.610		
	Conductivity (μ S/cm)	69.1	68.400	67.100			72.700		
	Color-filter 0.45 μ m (degree)	58	52.000	46.000	-12%	-21%	47.000	-10%	-19%
	Turbidity (NTU)	44.5	40.400	35.200	-13%	-21%	32.200	-20%	-28%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.5	4.800	3.800	-21%	-16%	3.700	-23%	-18%
	E260*	0.146	0.137	0.101	-26%	-31%	0.109	-20%	-25%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.22	0.210	0.140	-33%	-36%	0.120	-43%	-45%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.008	0.007	0.006	-14%	-25%	0.006	-14%	-25%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.600	0.700	17%	17%	0.800	33%	33%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.038	0.029	0.014	-52%	-63%	0.011	-62%	-71%
	Dissolved-iron(d-Fe) (mg/L)	0.23	0.280	0.240	-14%	4%	0.220	-21%	-4%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 29 / 10 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.36			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			28/10 08:30			28/10 08:30		
	Sampling date and time		29/10 11:30	29/10 11:30			29/10 11:30		
	Filtration time after washing finished (h)			3h00		A/raw	3h00		B/raw
BASIC	Water temperature (°C)	31.2	31.600	31.500			31.800		
	pH	6.57	6.840	6.940			6.760		
	DO (mg/L)	0.84	7.190	1.820			2.430		
	Conductivity (μ S/cm)	60	72.000	63.200			76.000		
	Color-filter 0.45 μ m (degree)	21	19.000	13.000	-32%	-38%	18.000	-5%	-14%
	Turbidity (NTU)	37.5	34.200	26.300	-23%	-30%	26.000	-24%	-31%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.1	4.300	3.500	-19%	-15%	3.300	-23%	-20%
	E260*	0.119	0.109	0.104	-5%	-13%	0.105	-4%	-12%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.193	0.177	0.168	-5%	-13%	0.130	-27%	-33%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0038	0.0036	0.0027	-25%	-29%	0.0032	-11%	-16%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.800	0.700	-13%	-13%	0.700	-13%	-13%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.028	0.022	0.005	-77%	-82%	0.007	-68%	-75%
	Dissolved-iron(d-Fe) (mg/L)	0.11	0.100	0.100	0%	-9%	0.120	20%	9%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 05 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.36			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			05/11 08:30			05/11 08:30		
	Sampling date and time		05/11 13:30	05/11 13:30			05/11 13:30		
	Filtration time after washing finished (h)			5h00		A/raw	5h00		B/raw
BASIC	Water temperature (°C)	31.6	31.400	31.900			32.500		
	pH	6.28	7.100	7.010			7.020		
	DO (mg/L)	2.02	7.410	3.970			1.470		
	Conductivity (μ S/cm)	49.5	49.400	46.300			53.800		
	Color-filter 0.45 μ m (degree)	22	23.000	20.000	-13%	-9%	17.000	-26%	-23%
	Turbidity (NTU)	23	26.300	17.500	-33%	-24%	15.400	-41%	-33%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.5	5.400	3.200	-41%	-9%	3.000	-44%	-14%
	E260*	0.297	0.284	0.259	-9%	-13%	0.248	-13%	-16%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.05	0.050	0.030	-40%	-40%	0.020	-60%	-60%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.014	0.013	0.006	-54%	-57%	0.005	-62%	-64%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.4	0.400	0.500	25%	25%	0.500	25%	25%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.014	0.013	0.006	-54%	-57%	0.005	-62%	-64%
	Dissolved-iron(d-Fe) (mg/L)	0.15	0.160	0.150	-6%	0%	0.150	-6%	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 06 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.37			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			06/11 08:30			06/11 08:30		
	Sampling date and time		06/11 10:30	06/11 10:30			06/11 10:30		
	Filtration time after washing finished (h)			2h00		A/raw	2h00		B/raw
BASIC	Water temperature (°C)	31.3	31.700	31.900			31.900		
	pH	6.85	7.010	7.160			7.120		
	DO (mg/L)	1.47	7.120	4.510			4.850		
	Conductivity (μ S/cm)	49.7	43.200	41.000			42.700		
	Color-filter 0.45 μ m (degree)	21	23.000	24.000	4%	14%	21.000	-9%	0%
	Turbidity (NTU)	21.3	21.000	15.000	-29%	-30%	15.600	-26%	-27%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.3	3.200	2.600	-19%	-21%	2.700	-16%	-18%
	E260*	0.128	0.109	0.116	6%	-9%	0.125	15%	-2%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.25	0.230	0.200	-13%	-20%	0.230	0%	-8%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0029	0.0034	0.002	-41%	-31%	0.0012	-65%	-59%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.3	0.300	0.400	33%	33%	0.300	0%	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.009	0.010	0.009	-10%	0%	0.008	-20%	-11%
	Dissolved-iron(d-Fe) (mg/L)	0.14	0.150	0.160	7%	14%	0.140	-7%	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 13 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.37			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			13/11 08:30			13/11 08:30		
	Sampling date and time		13/11 11:00	13/11 11:00			13/11 11:00		
	Filtration time after washing finished (h)			2h30		A/raw	2h30		B/raw
BASIC	Water temperature (°C)	32	32.200	32.800			32.500		
	pH	6.35	6.540	6.830			6.890		
	DO (mg/L)	1.53	7.200	2.480			4.370		
	Conductivity (μ S/cm)	55.5	45.600	44.600			42.300		
	Color-filter 0.45 μ m (degree)	24	20.000	26.000	30%	8%	19.000	-5%	-21%
	Turbidity (NTU)	20	19.000	13.000	-32%	-35%	15.000	-21%	-25%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.4	3.200	2.600	-19%	-24%	2.800	-13%	-18%
	E260*	0.086	0.083	0.089	7%	3%	0.103	24%	20%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.111	0.121	0.085	-30%	-23%	0.091	-25%	-18%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0019	0.0027	0.0014	-48%	-26%	0.0023	-15%	21%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.4	0.400	0.400	0%	0%	0.400	0%	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.010	0.006	-40%	-50%	0.006	-40%	-50%
	Dissolved-iron(d-Fe) (mg/L)	0.12	0.120	0.140	17%	17%	0.130	8%	8%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 11 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.37			1.02		
	Treatment volume(L/min)			1.98			1.32		
	Running start date and time after washing finished			11/11 09:00			11/11 09:00		
	Sampling date and time		11/11 11:15	11/11 11:15			11/11 11:15		
	Filtration time after washing finished (h)			2h15		A/raw	2h15		B/raw
BASIC	Water temperature (°C)	31.3	31.300	32.000			31.100		
	pH	6.19	6.680	6.620			6.740		
	DO (mg/L)	1.09	7.190	3.440			2.350		
	Conductivity (μ S/cm)	60.4	61.800	62.200			67.500		
	Color-filter 0.45 μ m (degree)	21	20.000	20.000	0%	-5%	19.000	-5%	-10%
	Turbidity (NTU)	20.9	18.000	12.900	-28%	-38%	13.000	-28%	-38%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.1	3.800	3.100	-18%	-24%	3.000	-21%	-27%
	E260*	0.257	0.226	0.194	-14%	-25%	0.182	-19%	-29%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.09	0.070	0.050	-29%	-44%	0.030	-57%	-67%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.006	0.005	-17%	-17%	0.005	-17%	-17%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.400	0.500	25%	0%	0.600	50%	20%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.015	0.009	0.006	-33%	-60%	0.005	-44%	-67%
	Dissolved-iron(d-Fe) (mg/L)	0.14	0.150	0.140	-7%	0%	0.140	-7%	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 18 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.37			1.02		
	Treatment volume(L/min)			2.00			1.40		
	Running start date and time after washing finished			18/11 08:30			18/11 08:30		
	Sampling date and time		18/11 10:30	18/11 10:30			18/11 10:30		
	Filtration time after washing finished (h)			2h00		A/raw	2h00		B/raw
BASIC	Water temperature (°C)	31	32.200	31.800			31.700		
	pH	6.28	7.000	6.910			6.900		
	DO (mg/L)	1.69	7.180	4.110			3.690		
	Conductivity (μ S/cm)	52.6	49.100	48.000			51.300		
	Color-filter 0.45 μ m (degree)	19	26.000	20.000	-23%	5%	22.000	-15%	16%
	Turbidity (NTU)	18.3	15.900	14.700	-8%	-20%	15.300	-4%	-16%
ORGANIC COMPOUNDS	CODMn (mg/L)	3	3.300	2.700	-18%	-10%	2.500	-24%	-17%
	E260*	0.088	0.076	0.068	-11%	-23%	0.044	-42%	-50%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.07	0.060	0.050	-17%	-29%	0.040	-33%	-43%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.005	0.006	20%	0%	0.006	20%	0%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.600	0.700	17%	17%	0.700	17%	17%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.01	0.007	0.004	-43%	-60%	0.005	-29%	-50%
	Dissolved-iron(d-Fe) (mg/L)	0.08	0.090	0.100	11%	25%	0.110	22%	38%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 25 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.56			0.98		
	Treatment volume(L/min)			2.00			1.40		
	Running start date and time after washing finished			25/11 08:30			25/11 08:30		
	Sampling date and time		25/11 13:00	25/11 13:00			25/11 13:00		
	Filtration time after washing finished (h)			4h30		A/raw	4h30		B/raw
BASIC	Water temperature (°C)	30.9	30.800	31.100			31.300		
	pH	6.23	7.100	6.860			6.680		
	DO (mg/L)	0.74	7.380	3.200			2.440		
	Conductivity (μ S/cm)	79.1	77.700	73.000			75.600		
	Color-filter 0.45 μ m (degree)	10	12.000	10.000	-17%	0%	7.000	-42%	-30%
	Turbidity (NTU)	32.4	29.700	19.900	-33%	-39%	21.900	-26%	-32%
ORGANIC COMPOUNDS	CODMn (mg/L)	7.1	3.600	4.400	22%	-38%	3.100	-14%	-56%
	E260*	0.122	0.120	0.098	-18%	-20%	0.095	-21%	-22%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.31	0.200	0.020	-90%	-94%	0.020	-90%	-94%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.007	0.006	0.006	0%	-14%	0.006	0%	-14%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.700	0.800	14%	14%	0.900	29%	29%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.046	0.027	0.005	-81%	-89%	0.006	-78%	-87%
	Dissolved-iron(d-Fe) (mg/L)	0.06	0.070	0.070	0%	17%	0.070	0%	17%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 26 / 11 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.55			0.98		
	Treatment volume(L/min)			2.00			1.40		
	Running start date and time after washing finished			26/11 08:00			26/11 08:00		
	Sampling date and time		26/11 10:30	26/11 10:30			26/11 10:30		
	Filtration time after washing finished (h)			2h30		A/raw	2h30		B/raw
BASIC	Water temperature (°C)	30.7	31.200	31.600			31.500		
	pH	6.63	7.160	7.130			6.740		
	DO (mg/L)	1.2	7.240	2.750			1.670		
	Conductivity (μ S/cm)	80	72.300	88.000			74.000		
	Color-filter 0.45 μ m (degree)	34	3.100	32.000	932%	-6%	32.000	932%	-6%
	Turbidity (NTU)	25.4	25.100	17.600	-30%	-31%	14.200	-43%	-44%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.3	4.200	3.000	-29%	-30%	2.950	-30%	-31%
	E260*	0.128	0.073	0.067	-8%	-48%	0.079	8%	-38%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.494	0.372	0.184	-51%	-63%	0.203	-45%	-59%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.005	0.003	-40%	-50%	0.002	-60%	-67%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.500	0.600	20%	20%	0.700	40%	40%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.051	0.039	0.004	-90%	-92%	0.008	-79%	-84%
	Dissolved-iron(d-Fe) (mg/L)	0.11	0.140	0.150	7%	36%	0.140	0%	27%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 08 / 12 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.49			0.97		
	Treatment volume(L/min)			2.01			1.40		
	Running start date and time after washing finished			08/12 08:00			08/12 08:00		
	Sampling date and time		08/12 10:10	08/12 10:10			08/12 10:10		
	Filtration time after washing finished (h)			2h10		A/raw	2h10		B/raw
BASIC	Water temperature (°C)	30.6	30.700	31.100			30.800		
	pH	6.45	6.970	7.040			6.950		
	DO (mg/L)	1.87	7.440	3.290			2.830		
	Conductivity (μ S/cm)	64	58.100	56.000			60.600		
	Color-filter 0.45 μ m (degree)	18	12.000	12.000	0%	-33%	14.000	17%	-22%
	Turbidity (NTU)	23.1	21.300	3.500	-84%	-85%	12.200	-43%	-47%
ORGANIC COMPOUNDS	CODMn (mg/L)	2.9	3.000	3.400	13%	17%	3.100	3%	7%
	E260*	0.113	0.110	0.086	-22%	-24%	0.113	3%	0%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.1	0.080	0.060	-25%	-40%	0.060	-25%	-40%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.003	0.004	33%	0%	0.002	-33%	-50%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.400	0.500	25%	0%	0.500	25%	0%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.015	0.012	0.001	-92%	-93%	0.003	-75%	-80%
	Dissolved-iron(d-Fe) (mg/L)	0.09	0.100	0.090	-10%	0%	0.090	-10%	0%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Air Supply (change flow)

Measurement date : 10 / 12 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.49			0.97		
	Treatment volume(L/min)			2.01			1.40		
	Running start date and time after washing finished			10/12 09:00			10/12 09:00		
	Sampling date and time		10/12 11:00	10/12 11:00			10/12 11:10		
	Filtration time after washing finished (h)			2h00		A/raw	2h00		B/raw
BASIC	Water temperature (°C)	30	29.700	30.300			30.300		
	pH	6.32	7.010	6.850			6.440		
	DO (mg/L)	1.66	7.620	3.300			3.350		
	Conductivity (μ S/cm)	70.8	69.200	71.200			74.100		
	Color-filter 0.45 μ m (degree)	18	20.000	16.000	-20%	-11%	15.000	-25%	-17%
	Turbidity (NTU)	21.1	19.200	14.100	-27%	-33%	15.100	-21%	-28%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.6	3.300	2.800	-15%	-22%	2.900	-12%	-19%
	E260*	0.254	0.260	0.220	-15%	-13%	0.249	-4%	-2%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.18	0.140	0.080	-43%	-56%	0.070	-50%	-61%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.006	0.006	0.004	-33%	-33%	0.005	-17%	-17%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.5	0.600	0.900	50%	80%	0.900	50%	80%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.031	0.026	0.006	-77%	-81%	0.003	-88%	-90%
	Dissolved-iron(d-Fe) (mg/L)	0.14	0.160	0.130	-19%	-7%	0.130	-19%	-7%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC 2 days

Measurement date : 25 / 12 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)									
	Treatment volume(L/min)									
	Running start date and time after washing finished									
	Sampling date and time		25/12 9:30	25/12 9:30						
	Filtration time after washing finished (h)					A/raw			B/raw	
BASIC	Water temperature (°C)	28.9	29.100	29.300						
	pH	6.2	6.800	6.710						
	DO (mg/L)	5.17	7.260	3.480						
	Conductivity (μ S/cm)	124.9	122.600	121.500						
	Color-filter 0.45 μ m (degree)	29	31.000	32.000	3%	10%		-100%		
	Turbidity (NTU)	20.1	20.000	15.600	-22%	-22%		-100%		
ORGANIC COMPOUNDS	CODMn (mg/L)	4.3	4.000	3.300	-18%	-23%		-100%	-100%	
	E260*	0.132	0.125	0.120	-4%	-9%		-100%	-100%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.5	0.460	0.080	-83%	-84%		-100%	-100%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.061	0.055	0.006	-89%	-90%		-100%	-100%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.900	1.000	11%	25%		-100%	-100%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.047	0.040	0.008	-80%	-83%		-100%	-100%	
	Dissolved-iron(d-Fe) (mg/L)	0.24	0.260	0.300	15%	25%		-100%	-100%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC 2 days

Measurement date : 30 / 12 / 2014

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin						
				Treated water by NO.A BCF			Treated water by NO.B BCF			
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)									
	Activated Carbon Layer height (m)									
	Treatment volume(L/min)									
	Running start date and time after washing finished			29/12 10:00						
	Sampling date and time		30/12 9:00	30/12 9:00						
	Filtration time after washing finished (h)			23h		A/raw			B/raw	
BASIC	Water temperature (°C)	28.5	28.700	28.700						
	pH	6.04	6.810	6.870						
	DO (mg/L)	1.64	7.510	5.270						
	Conductivity (μ S/cm)	93.7	93.200	89.500						
	Color-filter 0.45 μ m (degree)	28	29.000	26.000	-10%	-7%		-100%	-100%	
	Turbidity (NTU)	20.2	19.400	17.200	-11%	-15%		-100%	-100%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4	4.000	3.500	-13%	-13%		-100%	-100%	
	E260*	0.154	0.157	0.132	-16%	-14%		-100%	-100%	
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.07	0.070	0.050	-29%	-29%		-100%	-100%	
	Nitrite-nitrogen(N-NO2) (mg/L)	0.007	0.008	0.007	-13%	0%		-100%	-100%	
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.600	0.900	50%	50%		-100%	-100%	
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.016	0.012	0.007	-42%	-56%		-100%	-100%	
	Dissolved-iron(d-Fe) (mg/L)	0.27	0.280	0.270	-4%	0%		-100%	-100%	

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 06 / 01 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)								
	Treatment volume(L/min)								
	Running start date and time after washing finished			05/01 10:00					
	Sampling date and time		06/01 8:00	06/01 8:00					
	Filtration time after washing finished (h)			22h		A/raw			B/raw
BASIC	Water temperature (°C)	27.6	27.200	27.100					
	pH	6.18	6.800	6.730					
	DO (mg/L)	1.08	7.720	4.460					
	Conductivity (μ S/cm)	147.9	149.600	146.000					
	Color-filter 0.45 μ m (degree)	30	32.000	25.000	-22%	-17%		-100%	
	Turbidity (NTU)	24.7	20.400	14.300	-30%	-42%		-100%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4.4	4.500	3.600	-20%	-18%		-100%	-100%
	E260*	0.114	0.120	0.069	-43%	-39%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.28	0.240	0.080	-67%	-71%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.015	0.014	0.008	-43%	-47%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.7	0.700	0.800	14%	14%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.049	0.039	0.010	-74%	-80%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.34	0.350	0.320	-9%	-6%		-100%	-100%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 08 / 01 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)								
	Treatment volume(L/min)			1.30					
	Running start date and time after washing finished			07/01 10:00					
	Sampling date and time		06/01 8:00	08/01 8:23					
	Filtration time after washing finished (h)			20h		A/raw			B/raw
BASIC	Water temperature (°C)	27.9	28.000	28.000					
	pH	6.52	6.910	6.820					
	DO (mg/L)	1.71	7.690	4.720					
	Conductivity (μ S/cm)	149	151	147.000					
	Color-filter 0.45 μ m (degree)	15	15.000	12.000	-98%	-20%		-100%	
	Turbidity (NTU)	17.6	16.700	0.280	-13%	-98%		-100%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4.2	4.000	3.500	-44%	-17%		-100%	-100%
	E260*	0.099	0.104	0.058	-77%	-41%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.256	0.218	0.051	-56%	-80%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0034	0.004	0.0017	40%	-50%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.6	0.5	0.700	-86%	17%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.04	0.029	0.004	-43%	-90%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.07	0.070	0.040	#DIV/0!	-43%		-100%	-100%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 22 / 01 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.55					
	Treatment volume(L/min)			2.00					
	Running start date and time after washing finished			26/01 10:00					
	Sampling date and time		27/01 08:15	27/01 08:15					
	Filtration time after washing finished (h)			22h15		A/raw			B/raw
BASIC	Water temperature (°C)	26.4	26.300	26.000					
	pH	6.54	6.840	6.820					
	DO (mg/L)	1.65	7.840	5.290					
	Conductivity (μ S/cm)	114.4	112.4	110.100					
	Color-filter 0.45 μ m (degree)	11	3.000	3.000	0%	-73%		-100%	
	Turbidity (NTU)	30	24.200	20.600	-15%	-31%		-100%	
ORGANIC COMPOUNDS	CODMn (mg/L)	4	3.800	3.200	-16%	-20%		-100%	-100%
	E260*	0.112	0.085	0.081	-5%	-28%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.08	0.080	0.060	-25%	-25%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.004	0.003	-25%	-25%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.9	1.4	1.000	-29%	11%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.012	0.012	0.007	-42%	-42%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.05	0.080	0.070	-13%	40%		-100%	-100%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 29 / 01 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.62					
	Treatment volume(L/min)			2.00					
	Running start date and time after washing finished			28/01 10:00					
	Sampling date and time		29/01 09:00	29/01 09:00					
	Filtration time after washing finished (h)			23h00		A/raw			B/raw
BASIC	Water temperature (°C)	26.4	26.500	26.700					
	pH	6.11	6.930	6.780					
	DO (mg/L)	1.85	7.790	5.140					
	Conductivity (μ S/cm)	47.7	58.7	68.900					
	Color-filter 0.45 μ m (degree)	28	24.000	25.000	4%	-11%		-100%	-100%
	Turbidity (NTU)	36.5	35.300	24.700	-30%	-32%		-100%	-100%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.2	4.700	3.700	-21%	-12%		-100%	-100%
	E260*	0.224	0.230	0.169	-27%	-25%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.07	0.080	0.050	-38%	-29%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.004	0.004	0.003	-25%	-25%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.9	0.8	0.800	0%	-11%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.017	0.015	0.008	-47%	-53%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.08	0.090	0.090	0%	13%		-100%	-100%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 02 / 02 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.59					
	Treatment volume(L/min)			2.00					
	Running start date and time after washing finished			01/02 10:00					
	Sampling date and time		02/02 08:15	02/02 08:15					
	Filtration time after washing finished (h)			22h15		A/raw			B/raw
BASIC	Water temperature (°C)	26.9	27.000	27.100					
	pH	6.54	7.020	7.010					
	DO (mg/L)	0.97	8.210	4.630					
	Conductivity (μ S/cm)	324	334	360.000					
	Color-filter 0.45 μ m (degree)	12	13.000	10.000	-23%	-17%		-100%	-100%
	Turbidity (NTU)	17.2	15.000	22.200	48%	29%		-100%	-100%
ORGANIC COMPOUNDS	CODMn (mg/L)	4.2	4.400	5.300	20%	26%		-100%	-100%
	E260*	0.062	0.068	0.055	-19%	-11%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.105	0.094	0.037	-61%	-65%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.0093	0.004	0.0031	-26%	-67%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	1.3	0.700	-46%	-13%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.036	0.021	0.008	-62%	-78%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.03	0.050	0.040	-20%	33%		-100%	-100%

Evaluating measurement for BCF pilot plant at Tan Hiep WTP (Hoa Phu Intake Station)

After Wash GAC

Measurement date : 04 / 02 / 2015

Sampling place		Raw water	Raw water after air supply	Pre-sedimentation Basin					
				Treated water by NO.A BCF			Treated water by NO.B BCF		
RUNNING CONDITION	Pre-Chlorine (mg/L at intake)								
	Activated Carbon Layer height (m)			1.59					
	Treatment volume(L/min)			2.00					
	Running start date and time after washing finished			03/02 10:00					
	Sampling date and time		04/02 08:00	04/02 08:00					
	Filtration time after washing finished (h)			22h00		A/raw			B/raw
BASIC	Water temperature (°C)	24.7	24.900	25.000					
	pH	6.32	7.100	6.890					
	DO (mg/L)	1.29	7.900	4.550					
	Conductivity (μ S/cm)	514	592	615.000					
	Color-filter 0.45 μ m (degree)	8	10.000	7.000	-30%	-13%		-100%	-100%
	Turbidity (NTU)	20.4	22.500	12.000	-47%	-41%		-100%	-100%
ORGANIC COMPOUNDS	CODMn (mg/L)	3.7	4.300	2.900	-33%	-22%		-100%	-100%
	E260*	0.153	0.164	0.130	-21%	-15%		-100%	-100%
NITROGEN	Ammonium-nitrogen(N-NH4) (mg/L)	0.16	0.120	0.040	-67%	-75%		-100%	-100%
	Nitrite-nitrogen(N-NO2) (mg/L)	0.01	0.009	0.008	-11%	-20%		-100%	-100%
	Nitrate-nitrogen(N-NO3) (mg/L)	0.8	0.8	1.000	25%	25%		-100%	-100%
DISSOLVED METAL	Dissolved-manganese(d-Mn) (mg/L)	0.054	0.041	0.006	-85%	-89%		-100%	-100%
	Dissolved-iron(d-Fe) (mg/L)	0.09	0.090	0.080	-11%	-11%		-100%	-100%

添付資料－ 4

・ EVALUATION REPORT

U-BCF PILOT STUDY
ON
TAN HIEP WATER TREATMENT PLANT
IN
HO CHI MINH CITY, VIETNAM

EVALUATION REPORT (DRAFT)

MARCH 2015

SAIGON WATER CORPORATION (SAWACO)
HAIPHONG WATER SUPPLY ONE MEMBER LIMITED COMPANY
WATER AND SEWER BUREAU, CITY OF KITAKYUSHU

12th March 2015, Ho Chi Minh

The Evaluation Report (Final) will be prepared based on the Evaluation Report (Draft), which is confirmed by:

Deputy Manager of Water Quality Department Saigon Water Corporation	Technical Staff Haiphong Water Supply One Member Limited Company
 <u>TRAN KIM THACH</u>	 <u>LUONG HUU LUAN</u>
Assistant Manager of International Project Division, Water and Sewer Bureau, City of Kitakyushu	Witness:
 <u>YAYAMA Masashi</u>	

U-BCF PILOT STUDY
ON
TAN HIEP WATER TREATMENT PLANT
IN
HO CHI MINH CITY, VIETNAM

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1 OUTLINE OF THE U-BCF PILOT STUDY IN 2014

1.1 Background of the study

1-1-1 Issues of SAWACO

The SAIGON Water Corporation (to be referred to as "SAWACO" from now on) that conducts water service business in Vietnam's largest city, Ho Chi Minh City, is currently Vietnam's large water service utility having a supply capacity of 1.55million m³ / day. SAWACO also has the role of being Vietnam's leading institution of the water service industry in the entire nation of Vietnam. However, SAWACO also faces serious issues that are unique to large cities. They are mainly concentrated in the following 3 items.

- ① The demand for water is expected to increase in Ho Chi Minh City with the anticipated increase in the population and economic development. It will be necessary to develop water sources and expand water service facilities to cope with this increase.
- ② In addition to industrialization and urbanization, the delay in preparation of sewage treatment facilities is causing the river that is the raw water source to progressively become polluted. Within this situation, effective measures to strictly adhere to water quality standards for Vietnam by SAWACO are require for the future.
- ③ In view that the water service is a public service that is the foundation for daily life of all citizens of Ho Chi Minh City, including the poor class, a sound business must be operated and in-expensive water tariff must be maintained.

1-1-2 Water Quality of Saigon River

The TAN HIEP water purification plant that uses the Saigon River as it water source is the 2nd in scale of main water treatment plants of SAWASO and has the capacity to purify a volume of 300,000m³ daily. Additionally, construction for a PFI project (2nd TAN HIEP Project) to further increase this volume an additional 300,000m³ per day has been started.

However, when this PFI project is completed, a volume of 600,000m³ of raw water per day will be taken from the



Figure 1-1 Intake Pipe

Saigon River and conducted to the TAN HIEP water treatment plant. However, the seriousness of wastewater from households and factories polluting the Saigon River with organic matter was increasing each year.

1-1-3 Long Distance Water Conduit Plan

SAWACO has included preparation of a long distance water conduit in their Master Plan from the DAU TIENG Lake or the TRI AN lake to correspond with the future increase in demand for water and the deterioration of water quality of the Saigon River. However, according to Draft Final Report "THE STUDY ON WATER SUPPLY IMPROVEMENT IN HO CHI MINH CITY" (Appendix-1)

submitted by JICA to SAWACO in June of 2013, the cost of the long distance water conduit project would be over 1 billion US dollars and there is a concern that implementing the long distance water conduit project may require a significant rise in water tariff.

1-1-4 Necessity for Advanced Water Treatment

Positive results can be expected in regards to the water quality problems of the Saigon River with the DAU TIENG lake or TRI AN lake long distance water conduit project and while being positioned as an option to solving the problem of water quality, owing the huge costs involved, research on Advanced Treatment to resolve the treatment process of the raw water from the Saigon River is also being carried out.

For the plan to take 600,000m³ of water daily from the Saigon River the implementation of Advanced Treatment would solve the problem of water quality and for water taken that exceeds this volume, consideration of the long distance water conduit could be the most economical project plan.

1.2 U-BCF Pilot Study in SAWACO

1-2-1 U-BCF Project in Haiphong

Currently, aggressive technical cooperation is being undertaken between Japan's Kitakyushu City and Vietnam's Hai Phong City in based on the sister city relationship of the cities. Particularly, the U-BCF (Upward Biological Contact Filter) project to improve the water quality of Hai Phong City is moving from pilot study stage to the preparatory project stage and a small scale water treatment plant (VINH BAO Water Treatment Plant) has already been established in Hai Phong City and plans to equip U-BCF in other water treatment plans including main water treatment plants are going forward.

1-2-2 The First Contact between SAWACO and Kitakyushu

Around mid March of 2013 when the U-BCF pilot study was carried out in Hai Phong City, a group led by Mr. Vo Quang Chau, Vice General Director of SAWACO, visited the Hai Phong Water Supply One Member CO., LTD (to be referred to as "Haiphong Water" from now on) and conducted research on U-BCF technology and its effects. At this time, Mr. Vo Quang Chau and Mr. KUBOTA Kazuya (Director in charge of international projects) who is responsible for the U-BCF pilot study and belongs to the Water and Sewer Bureau, City of Kitakyushu (to be referred to as "K-Water" from now on) agreed for an exchange of views regarding the possibility of U-BCF demonstration experiments at SAWACO and after understanding the water quality situation of the Saigon River by Kitakyushu City, consultations of implementing U-BCF pilot study would be held again.

1-2-3 Location Survey Based on SAWACO Request

SAWACO issued a letter to K-Water regarding "Application of Biological Contact Filter (BCF) Technology" (Appendix-2) dated May 27, 2013 and after receiving this letter, K-Water dispatched 2 staff members to SAWACO at the end of June, 2013.

It was decided that U-BCF pilot study was possible for the water quality of the Saigon River

according to the results of the investigation and it was agreed that K-Water would search for a donor to support the experiment financially and submit this plan.

1-2-4 Ministry of Health, Labor and Welfare, Japan

The Japanese government that has jurisdiction over the Water Supply Division, Health Service Bureau, Ministry of Health, Labor and Welfare (to be referred to as "W-Ministry" from now on) received the request from K-Water and decided to consign "KOBELCO Eco-Solutions Co., LTD" that is familiar with U-BCF and has a subsidiary in Vietnam, for the implementation of the SAWACO U-BCF pilot study.

1-2-5 MOU Conclusion of U-BCF Pilot Study

On December 5, 2013, the three parties, SAWACO, K-Water and Haiphong Water entered into a memorandum at Kitakyushu concerning the implementation of the SAWACO pilot study. (Appendix-3) Because this pilot study was certified in the Vietnam-Japan Friendship Year (Japan Vietnam diplomatic relations 40 year anniversary) project, the resident Fukuoka Socialist Republic of Vietnam Consul General and the Mayor of Kitakyushu attended the conclusion.



Figure 2-2 MOU in Kitakyushu

1-3 Procedure of the Study

On January, 2014, KOBELCO and K-Water visited to the site and discussed the installation of U-BCF pilot equipment with SAWACO. As a result of the discussion, it was decided that the installation place could be in Hoa Phu intake station, where is approximately 10km far from Tan Hiep Water Treatment Plant. In order to get a good function of U-BCF, the procuring time is needed because U-BCF utilizes the natural purification by creature in raw water. Thus, installation of the pilot equipment completed by January, 2014, and the procuring time was secured using TET holiday.

1-4 Role Sharing

The responsibility for each implementing agency was decided with the discussion as shown in Table 1-1.

Table 1-1 Role Sharing for U-BCF Pilot Study

Utilities	Pilot Equipment				Pilot Study for One Year			
	Design	Materials	Making	Installation	Operation	Maintenance	Water Analysis	Evaluation
SAWACO	-	Responsibility	Responsibility	Responsibility	Responsibility	Responsibility	Responsibility	-
Kitakyushu Water	Engineering Assistance	Equipment Supply (1)	-	Engineering Assistance	Engineering Assistance	-	Engineering Assistance	Responsibility
Haiphong Water	-	-	-	Engineering Assistance	Engineering Assistance	Engineering Assistance	-	-
KOBELCO Vietnam	Responsibility	Equipment Supply (2)	Engineering Assistance	Engineering Assistance	-	Engineering Assistance	-	-

Equipment Supply (1): Kitakyushu Water donated to SAWACO some materials which was difficult to get in Vietnam, such as activate carbon.
Equipment Supply (2): KOBELCO donated to SAWACO some materials which was difficult to get in Vietnam, such as a transparent pipe (acrylic pipe) and others.

1-5 Pilot Equipment of U-BCF

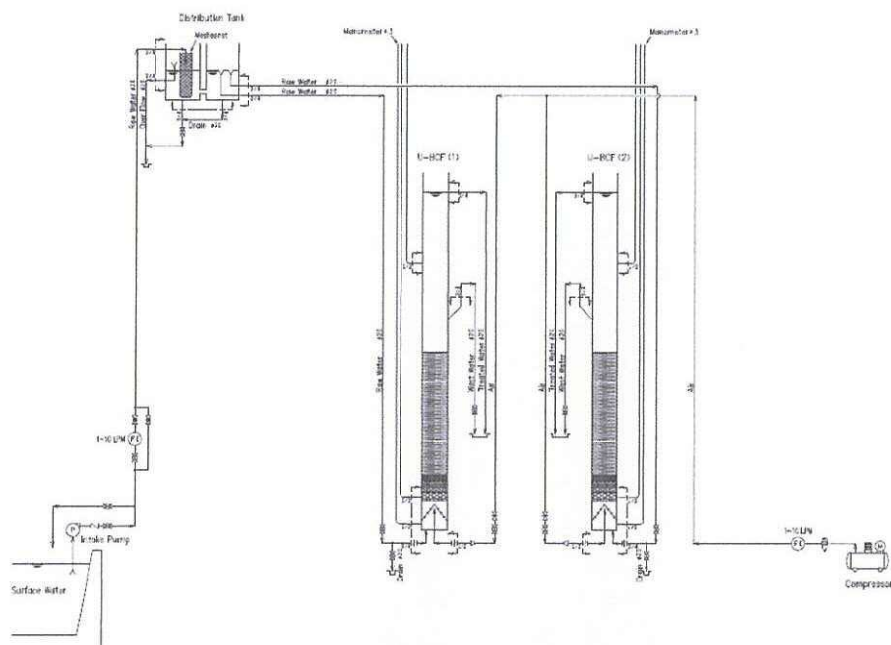


Figure 1-3 Layout of U-BCF Pilot Equipment



Figure 1-4 U-BCF Pilot Equipment

1-6 Duration of the Pilot Study

Term of Pilot study: February 2014 to January 2015

1-7 Participants

Referred to “2 OUTPUT OF THE PROJECT”

1-8 Joint Evaluation Meeting in SAWACO

1-8-1 Dates

March 12, 2015 9:00AM~11:30AM

1-8-2 Attendees

SAWACO :

K-Water :

Haiphong Water :

KOBELCO :

1-8-3 Main Evaluation Contents

- U-BCF and Saigon River Water Quality
- Correlation between Biological Treatment and DO
- Cause and Prevention of the Mud Ball Phenomenon
- Validity of the Pilot Study Period (1 year period from Feb. 2014 to Jan. 2015)

1-9 Final Report to W-Ministry

KOBELCO and K-Water will create a report in Japanese based on this evaluation report and this evaluation report (signed) will be attached and submitted to the W-Ministry at the end of March, 2015.

2 OUTPUT OF THE PROJECT

2.1 Project Implementation

This project was carried out at the Hoa Phu water intake location as the main activity base where the U-BCF pilot study equipment is installed up until now. The equipment and the personnel committed to this project by each implementing organization within the 14 month period from when this project was started until now are shown below.

2.1.1 Saigon Water Corporation

- Provide necessary technological information for pilot study and pilot study equipment
- Provide necessary space to install pilot study equipment
- Provide necessary staff, water quality testing room, water quality analysis equipment, reagents and office space for pilot study
- Foundation and supporting materials (steel materials) for production installation for pilot study installation equipment
- Payment of electricity fees related to cleaning and DO improvement
- Water quality analysis work (twice per week)
- Maintenance management work (activated carbon replenishment, cleaning, etc.)

Date	Name	Place	Task
3/12/2013– 10/12/2013	Vo Quang Chau (Vice General Director) Vo Quang Triet (Director of Tanhiep WTP)	Kitakyushu	Signing of MOU
13/01/2014– 18/01/2014	Vo Quang Triet (Director of Tanhiep WTP) Nguyen Huu Phuoc (Deputy director of Tanhiep WTP) Ngo Hong Viet Thai (Vice manager of Laboratory of Tanhiep WTP) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP) Tran Kim Thach (Deputy Manager of Water Quality Department) Tran Thanh Thuy (Specialist of Water Quality Department) Pham Bien Vien Tan (Specialist of Technology Department)	Hoaphu	Install U-BCF pilot equipment
17/01/2014– Up to now	Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP) Mai Cong Nhoc (Operator of Hoaphu pumping station) Pham Thanh Son (Operator of Hoaphu pumping station) Nguyen Minh Tan (Operator of Hoaphu pumping station) Nguyen Thanh Son (Operator of Hoaphu pumping station)	Hoaphu	Operate pilot equipment
17/01/2014– 17/03/2014 17/03/2014– Up to now	Ngo Hong Viet Thai (Vice manager of Laboratory of Tanhiep WTP) Lab analysts (Water Quality Department) Ngo Hong Viet Thai (Team Leader of Reserch team of Water Quality Department) Lab analysts (Water Quality Department)	Tanhiep Water Quality Dept.	Water quality analysis
13/01/2014– Up to now	Duong Hong Phuong (Manager of Cooperation and Development Department) Bui Hoai Nam (Vice manager of Cooperation and Development Department) Nguyen Nhat Duy (Specialist of Cooperation and Development Department) Pham Van Dong (Driver of Administration Department)	HCMC	Contact and transportation
21/05/2014– 28/05/2014	Tran Thanh Thuy (Specialist of Water Quality Department) Vo Thanh Tho (Team Leader of Water Quality Team of	Hoaphu	Examine Saigon river and first

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	Tanhiep WTP)		increase of DO
10/09/2014- 13/09/2014	Tran Thanh Thuy (Specialist of Water Quality Department) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP)	Hpaphu	Adjust U-BCF pilot and second increase of DO
17/09/2014- 24/09/2014	Vo Quang Chau (Vice General Director) Tran Kim Thach (Deputy Manager of Water Quality Department) Tran Thanh Thuy (Specialist of Water Quality Department) Vo Quang Triet (Director of Tanhiep WTP) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP) Duong Hong Phuong (Manager of Cooperation and Development Department) Bui Hoai nam (Vice manager of Cooperation and Development Department) Nguyen Nhat Duy (Specialist of Cooperation and Development Department) Tran Cuong (Vice manager of Technology Department) Vo Xuan Khanh (Specialist of Technology Department)	SAWACO	Interim report
21/12/2014- 26/12/2014	Tran Thanh Thuy (Specialist of Water Quality Department) Ngo Hong Viet Thai (Team leader of Research team of Water Quality Department) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP)	Hoaphu	Refreshing GAC
04/01/2015- 7/01/2015	Tran Thanh Thuy (Specialist of Water Quality Department) Ngo Hong Viet Thai (Team leader of Research team of Water Quality Department) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP)	Hoaphu	Replace flow-meter and air-meter
12/03/2015	Bui Thanh Giang (Vice General Director) Tran Kim Thach (Deputy Manager of Water Quality Department) Tran Thanh Thuy (Deputy Manager of Water Quality Department) Tran Thanh Thuy (Specialist of Water Quality Department) Ngo Hong Viet Thai (Team leader of Research team of Water Quality Department) Vo Quang Triet (Director of Tanhiep WTP) Vo Thanh Tho (Team Leader of Water Quality Team of Tanhiep WTP) Duong Hong Phuong (Manager of Cooperation and Development Department) Bui Hoai nam (Vice manager of Cooperation and Development Department) Nguyen Nhat Duy (Specialist of Cooperation and Development Department) Tran Cuong (Vice manager of Technology Department) Vo Xuan Khanh (Specialist of Technology Department)	SAWACO	Final report

2.1.2 Kitakyushu Water and Sewer Bureau

- Dispatch of necessary technical staff for pilot study
- Provide necessary U-BCF technical documentation and experience know-how necessary for implementation
- Advice and support for water quality test items
- Provide granular activated carbon (GAC)

Date	Name	Place	Task
3/12/2013– 10/12/2013	TOMIMASU Kenji (Director of Kitakyushu Water and Sewer Bureau)	Kitakyushu	Signing of MOU
13/01/2014–	YAYAMA Masashi (Specialist of International Project	Hoaphu	Install U-BCF pilot

*Draft Evaluation Report for U-BCF Pilot Study
In Tan Hiep Water Treatment Plant*

18/01/2014	Division)		equipment
5/03/2014- 8/03/2014	YAYAMA Masashi (Specialist of International Project Division)	Hoaphu	Confirm condition of pilot equipment
21/05/2014- 28/05/2014	YAYAMA Masashi (Specialist of International Project Division) HARAGUCHI Kimiko (Ex-Professor of Kitakyushu University)	Hoaphu	Examine Saigon river and first increase of DO
10/09/2014- 13/09/2014	YAYAMA Masashi (Specialist of International Project Division) HARAGUCHI Kimiko (Ex-Professor of Kitakyushu University)	Hpaphu	Adjust U-BCF pilot and second increase of DO
17/09/2014- 24/09/2014	KUBOTA Kazuya (Director of International Project Division) HARAGUCHI Kimiko (Ex-Professor of Kitakyushu University)	SAWACO	Interim report
21/12/2014- 26/12/2014	YAYAMA Masashi (Specialist of International Project Division) HARAGUCHI Kimiko (Ex-Professor of Kitakyushu University)	Hoaphu	Refreshing GAC
29/01/2015- 30/01/2015	TOMIMASU Kenji (Director of Kitakyushu Water and Sewer Bureau) KUBOTA Kazuya (Director of International Project Division) YAYAMA Masashi (Specialist of International Project Division)	SAWACO	Discussion next step
12/03/2015	KUBOTA Kazuya (Director of International Project Division) YAYAMA Masashi (Specialist of International Project Division) HARAGUCHI Kimiko (Ex-Professor of Kitakyushu University)	SAWACO	Final report

2.1.3 Haiphong Water Supply One Member Co., Ltd

- Dispatch of staff for installation of pilot study
- Support during pilot study
- Support replenishment of granular activated carbon

Date	Name	Place	Task
3/12/2013– 10/12/2013	Vu Hong Duong (General Director of Haiphong Water) Bui The Dung (Manager of Administration Department)	Kitakyushu	Signing of MOU
13/01/2014- 18/01/2014	Tran Van Duong (Vice General Director of Haiphong Water)	Hoaphu	Install U-BCF pilot equipment
12/03/2015	To be confirmed	SAWACO	Final report

2.1.4 Private Company (KOBELCO Eco-Solutions Vietnam and UNI-ELEX)

- Production of pilot study equipment
- Installation of DO improvement equipment
- Installation of cleaning equipment

Date	Name	Place	Task
13/01/2014- 18/01/2014	ISHIMARU Yutaka (Executive Technical Chief of KOBELCO) TOSHIMITU Shinji (Deputy General Director of UNI-ELEX)	Hoaphu	Install U-BCF pilot equipment
5/03/2014- 8/03/2014	MIYAGAWA Yuki (Sales Engineer of KOBELCO) Vu Quang Dong (Process Engineer of KOBELCO)	Hoaphu	Confirm condition of pilot equipment
21/05/2014-	MIYAGAWA Yuki (Sales Engineer of KOBELCO)	Hoaphu	Examine Saigon

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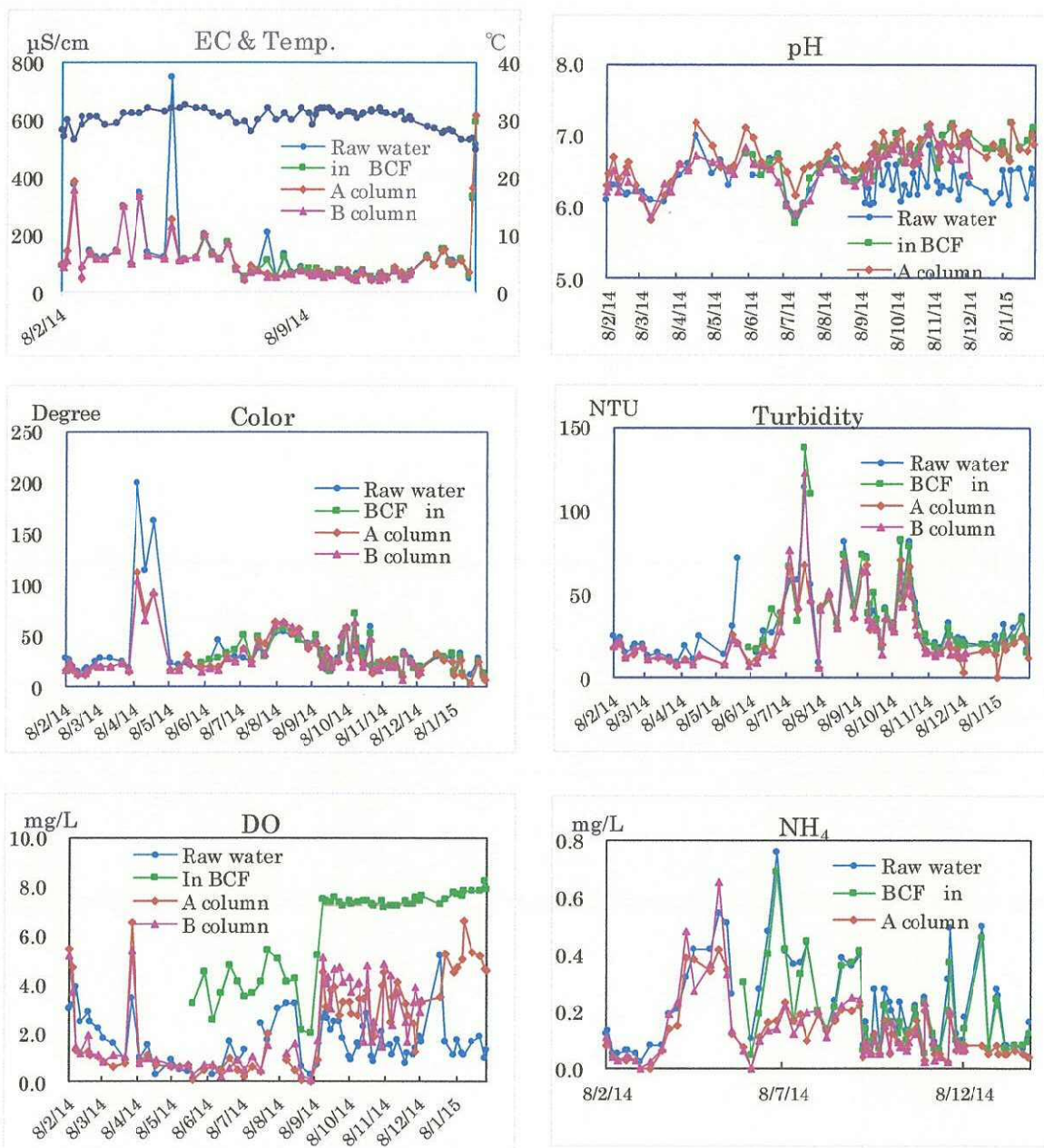
28/05/2014	Vu Quang Dong (Process Engineer of KOBELCO)		river and first increase of DO
10/09/2014- 13/09/2014	MIYAGAWA Yuki (Sales Engineer of KOBELCO) Vu Quang Dong (Process Engineer of KOBELCO)	Hoaphu	Adjust U-BCF pilot and second increase of DO
17/09/2014- 24/09/2014	MIYAGAWA Yuki (Sales Engineer of KOBELCO) Vu Quang Dong (Process Engineer of KOBELCO)	SAWACO	Interim report
21/12/2014- 26/12/2014	NISHIO Hironobu (Technical manager of KOBELCO) MIYAGAWA Yuki (Sales Engineer of KOBELCO) Vu Quang Dong (Process Engineer of KOBELCO)	Hoaphu	Refreshing GAC
03/01/2015- 07/01/2015	NISHIO Hironobu (Technical manager of KOBELCO)	Hoaphu	Installation of flow meter
12/03/2015	TOJI Akihiro (Technical manager of KOBELCO) MIYAGAWA Yuki (Sales Engineer of KOBELCO)	SAWACO	Final report

3 RESULT OF THE STUDY

3.1 Project Implementation

The U-BCF experimental plant results carried out in Ho Chi Minh City Saigon Water Supply Authority is shown below.

Water quality change for raw water, column A, column B is shown in the below graph. Because an air pump was installed in the raw water tank to increase DO from the end of May, 2014, the water quality after aeration is also shown at the same time.



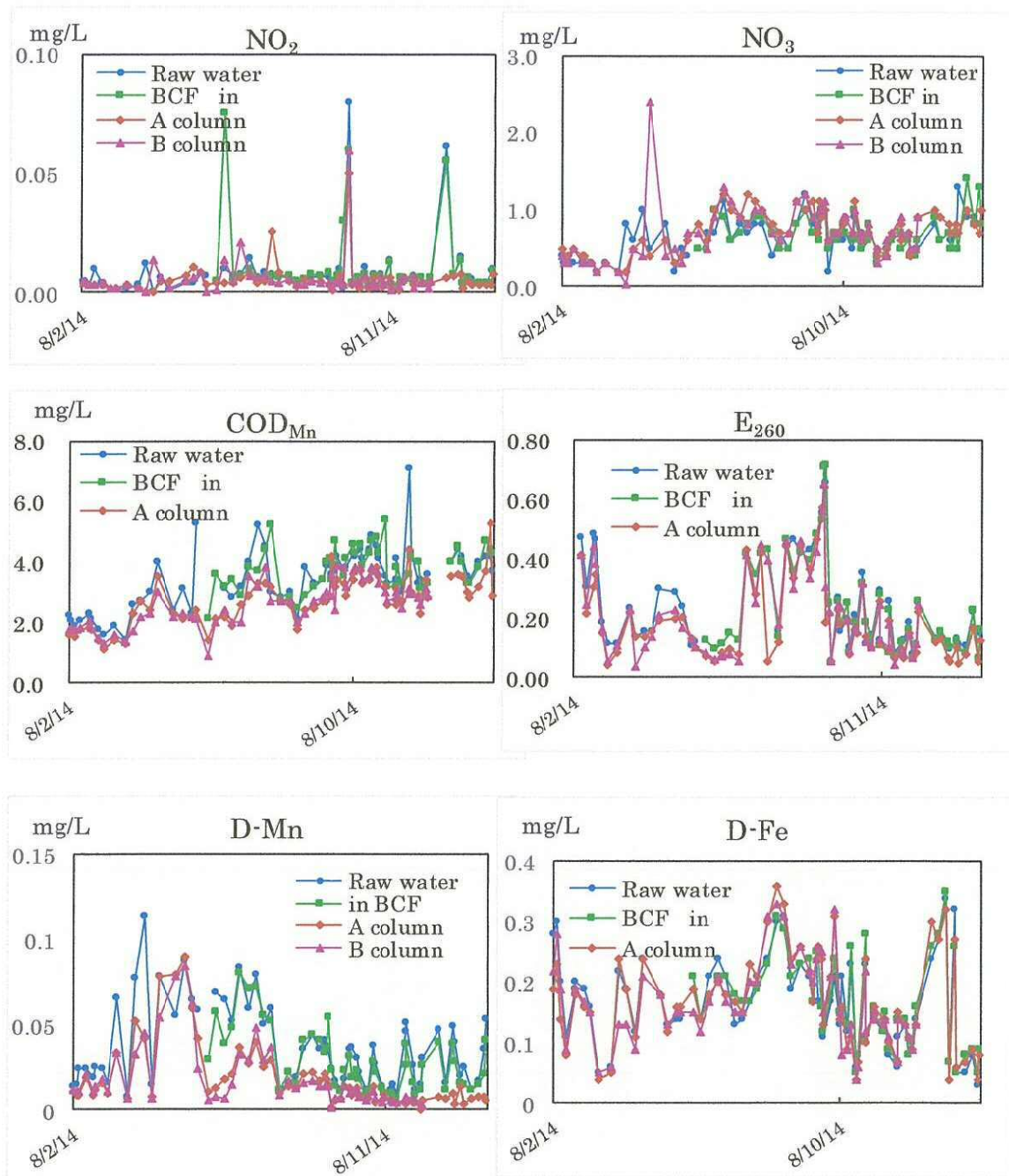


Table 3-1 Result of Water Quality Analysis

3.2 Raw Water Quality

The general quality of the raw water from Feb. 2014 until Feb 2015 during the testing is as follows.

- ① Water Temperature: Within the range of 32.5°C to 24.7°C and remain around 30°C with no significant fluctuation throughout the year.
- ② Electrical Conductivity: Fluctuated between 400 and 50 periodically from Feb. to July. There was an especially high value of 800 was shown in May. After Aug. to Jan. there was mostly no

fluctuation and was stable.

- ③ pH: In the range of 7 to 5.9 and average value of 6.3. A low value of 7 or less was shown throughout the year.
- ④ Color: A high value of 199 was shown in April however changed to below 50 degrees afterwards.
- ⑤ Turbidity: In the range of 114 to 9 NTU and average value of 34 was shown. There were large fluctuations between July and Nov. and from Dec. to April was stable at 30 or lower.
- ⑥ DO: Average value of 1.7mg/L and water hyacinth flourished in the basin and there was a very low value despite the active reproduction of algae.
- ⑦ NH₄: In the range of 0.76 to 0.02 and average value of 0.21mg/L. Was low and stable from Jan. To March, however the fluctuations were large fluctuations during other periods.
- ⑧ NO₂: In the range of 0.08 to 0.0mg/L and high concentrations were shown numerous times, however large fluctuations were hardly seen.
- ⑨ NO₃: In the range of 1.3 to 0.2mg/L and almost no fluctuations seen.
- ⑩ COD: In the range of 7.1 to 1.5 and average value of 3.5mg.
- ⑪ E260: In the range of 0.72 to 0.1 and average value of 0.24. The fluctuations in the period between July and Sept. had a tendency to be larger than other periods.
- ⑫ D-Mn: In the range of 0.11 to 0.008 and average value of 0.036mg/L. A relatively high concentration was show between March and July.
- ⑬ D-Fe: In the range of 0.34 to 0.03 and average value of 0.17mg/L. Overall, there was a tendency for large fluctuations.

3.3 Dissolved Oxygen (DO)

- ① A characteristic of the quality of the raw water is that pH and DO is low. Especially when DO is low for BCF, it is likely to affect the growth of the attachment microorganisms.
- ② NH₄, D-Mn, COD were the main objects of this experiment for BCF effect index items. However, from the beginning of the experiment, the removal rate was low for these items and from the second month of starting for NH₄ and the third month of starting for Mn from, there was practically no removal effect.
- ③ It was determined that the main cause was that DO was low and so an air pump was placed into the raw water tank and air was sent in. May, 26. At the same time, since algae were largely reproducing on the inner wall of the BCF column, a shade was placed on the outer wall.
- ④ After this, the removal rate of NH₄ and D-Mn recovered to a degree however, it did not match the results previously achieved in Kitakyushu or Hai Phong. The raw water DO did not stabilize and the DO after passing through the BCF column was about 1mg/L and the volume of consumption of DO was large. Therefore, in order to further increase the DO of raw water, a blowing device using a compressor was installed in the raw water tank. This resulted in the raw water DO increasing and maintaining stabilization at 7mg/L or higher and almost 2mg/L or higher was shown even after passing through BCF. After this, the D-Mn removal rate was fairly stable; however, the NH₄ removal rate did not improve.

3.4 PCR Test

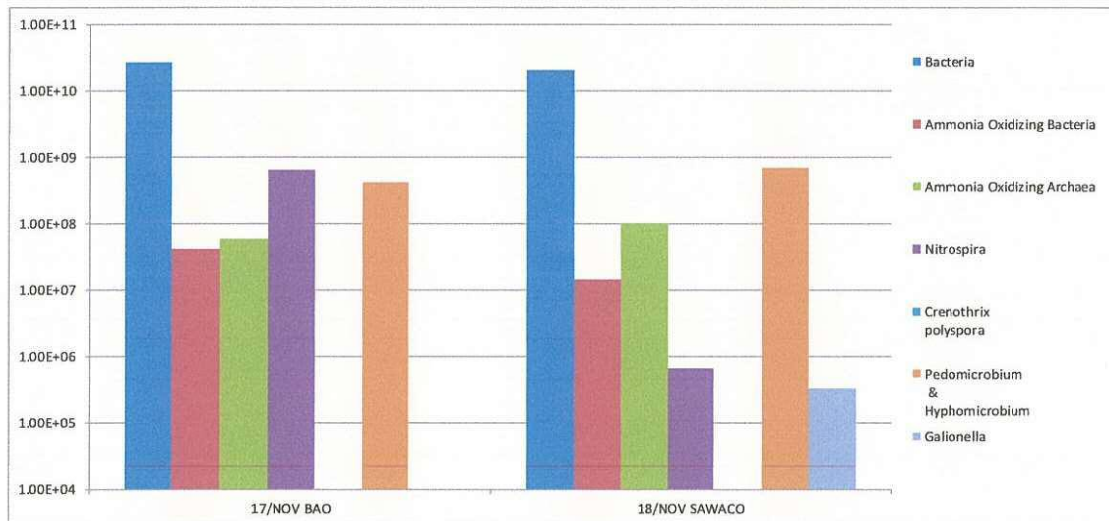
It was thought the cause of the above was that was a possibility the BCF microorganisms were not sufficiently growing and so the activated carbon being used and the type of attachment microorganisms were investigated. The results were that bacteria that remove ammonia and manganese, bacteria that oxidize ammonia and such as ammonia oxidizing bacteria, ammonia oxidizing archaea, nitrite oxidizing bacteria, manganese oxidizing bacteria were detected.

At the same time, the same bacteria were detected in the BCF implemented in the Haiphong Water Service Vinh Bao Purification Plant and the quantity was almost the same. Additionally, the same results were obtained in an investigation in Japan.

Because of this, from this experiment it was found that there were sufficient microorganisms inhabiting the BCF to remove D-Mn. Bacteria that remove iron, iron bacteria, were not detected in the Binbao water treatment plants, however they were detected in this BCF experiment column and the quantity was about one-one thousandth of what was detected in Japan.

Table 3-2 Result of PCR Test

Sample Name	Bacteria	Nitrifying Bacteria			Fe· Mn Oxidizing Bacteria		
		Ammonia Oxidizing Bacteria	Ammonia Oxidizing Archaea	<i>Nitrospira</i>	<i>Crenothrix polyspora</i>	<i>Pedomicrobium</i> & <i>Hyphomicrobium</i>	<i>Gallionella</i>
	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC	copies/g AC
17/NOV BAO	2.67E+10	4.12E+07	5.88E+07	6.28E+08	undetectable	4.17E+08	undetectable
18/NOV SAWACO	2.05E+10	1.43E+07	9.98E+07	6.60E+05	undetectable	6.78E+08	3.21E+05



4 TECHNICAL ISSUE TO BE FOUND AND MEASUREMENT

4.1 Algae

Because U-BCF utilizes living organisms in a natural cleaning process, chlorine cannot be used within the U-BCF facilities. Since this environment is favorable for the growth of algae, if the algae growth becomes significant, clogging of filtration may become an issue. When the inside of the column was confirmed 4 months after installation, adhesion of algae was conspicuous and the amount of adhesion was more than the situation at Hai Phong. The cause was thought to be the influence of longer hours of sunshine throughout the year in the southern area.



Figure 4-1 Condition of Algae

As a countermeasure, a shade to block sunlight from the overall column was proposed and the frequency of cleaning carried out from once every 2 days to once everyday was also proposed. The results were that adhesion of algae was reduced.

4.2 Dissolved Oxygen (DO)

A characteristic of the Saigon River is that the dissolved oxygen (DO) in the river is low. (DO: 0.3mg/L, April 24, 2014 measurements) This is thought to be a cause to deteriorate the capability of U-BCF. For this reason, the Kitakyushu water and sewage station proposed installing a device to increase DO in the pilot study equipment and have the Saigon Water Company carryout follow-up observations. DO improvement was implemented twice thought this pilot study. (1st time: May 26, 2nd time Sept. 10)

4.2.1 Improvement of DO (1st step)

The raw water of the Saigon River that was the objective raw water of the pilot study was used and in order to confirm the time required to raise the level of DO, beaker experiments were carried out. The volume of distribution of the upper area of the pilot plant was 5.0L and since the inflow volume was 5.0L/min, the retention time of the distribution tank was 1 minute. The results of the experiment confirmed that in about 1 minute, the DO increased to approximately 5.0mg/L and therefore the air pump shown in Figure 4-2 was brought from Japan and installed in the distribution tank.

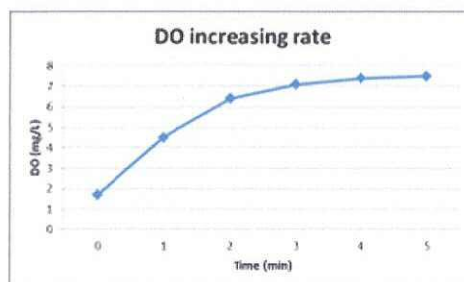


Table 4-1 DO increasing rate



Figure 4-2 Air Brower Equipment



Figure 4-3 Distributed Tank

As shown in Figure 4-3, the air pump was installed in the distribution tank on the top area of the column. Measurements of DO in the raw water before and after improvements were before improvements DO was 1.2mg/L and after improvements, DO was 4.4mg/L and confirmed increase in DO. (Table 4-2) The pilot study was conducted under this condition for 3 months but when the water quality was analyzed, significant improvement related to the processing results of U-BCF could not be obtained. Then when the outlet of the column was examined, a low value of 0.9mg/L was shown and it was determined that additional DO was necessary for organisms to be active in the activated charcoal.

Table 4-2 Result of DO Improvement (1st step)

	Before 14:30 23/May/2014	After 10:30 26/May/2014
Column A (Sand Layer 1.5m)	1.2 mg/L	4.4 mg/L
Column B (Sand Layer 1.0m)	1.2 mg/L	4.4 mg/L

4.2.2 Improvement of DO (2nd step)

In order to further increase DO, a mixing tank set before the distribution tank and providing sufficient air and securing retaining time is necessary. So then Kobelco Eco-Solutions designed and produced the mixing tank below and installed it on the roof of the building adjacent to the pilot study equipment.

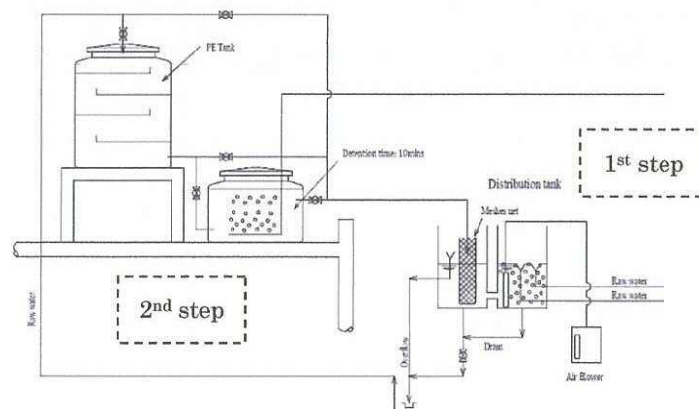


Figure 4-4 Layout of DO Equipment



Figure 4-5 Picture of Mixing Tank

With the introduction of this mixing tank, the DO before passing through the U-BCF pilot equipment increased to 7.33mg/L and additionally the DO was 3.58mg/L after passing through the equipment. From these results, it was determined that the necessary DO required for the organisms living in the GAC to be active was secured. The DO values at various points after improvement of the equipment are shown below in Table 4-3.

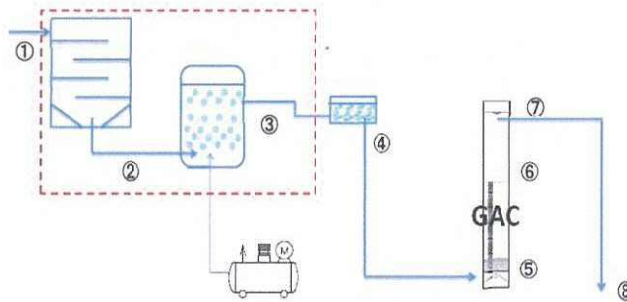


Table 4-3 DO Analysis

Unit: mg/L

	①	②	③	④	⑤	⑥	⑦	⑧
DO Modification 11/SEP/2014	1.25	4.94	7.53	7.55	7.33	3.58	3.64	7.11

As shown in Table 4-4, after the 2nd improvement of equipment, the DO fluctuated within the range of 7.00mg/L to 8.00mg/L and displayed stable values.

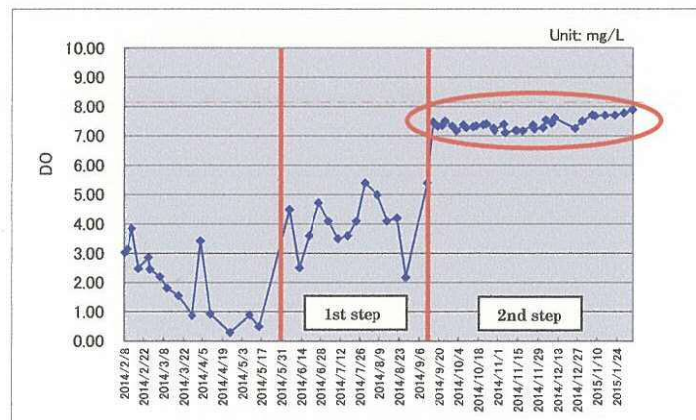


Table 4-4 Result of DO Analysis

4.3 GAC (Granular Activated Carbon) Clogged

Fundamentally, by having the activated charcoal (GAC) in the column flow upwards, it is necessary to secure sufficient time for contact. However, After 1 year from the start of the experiment in December of 2014 when the operational condition of the pilot equipment was confirmed, there was no movement of the activated charcoal in the lower area of the column and fluidity had decreased and sufficient contact time could not be secured. This was thought to be caused by algae and turbidity adhering to the lower water collection device and in the GAC inhibiting flow. Additionally, the diameter of the column used in the pilot study was 100mm and small and possibly easily clogged.

In order to improve the fluidity of the GAC, the GAC and the gravel in the column were temporarily removed and were cleaned. The GAC removed using a siphon was to be reused and was hand washed with raw water in order to protect the organisms. There was sufficient stock of the gravel which was supporting material and so it was exchanged with new gravel. The retention of turbidity in the activated carbon was confirmed.

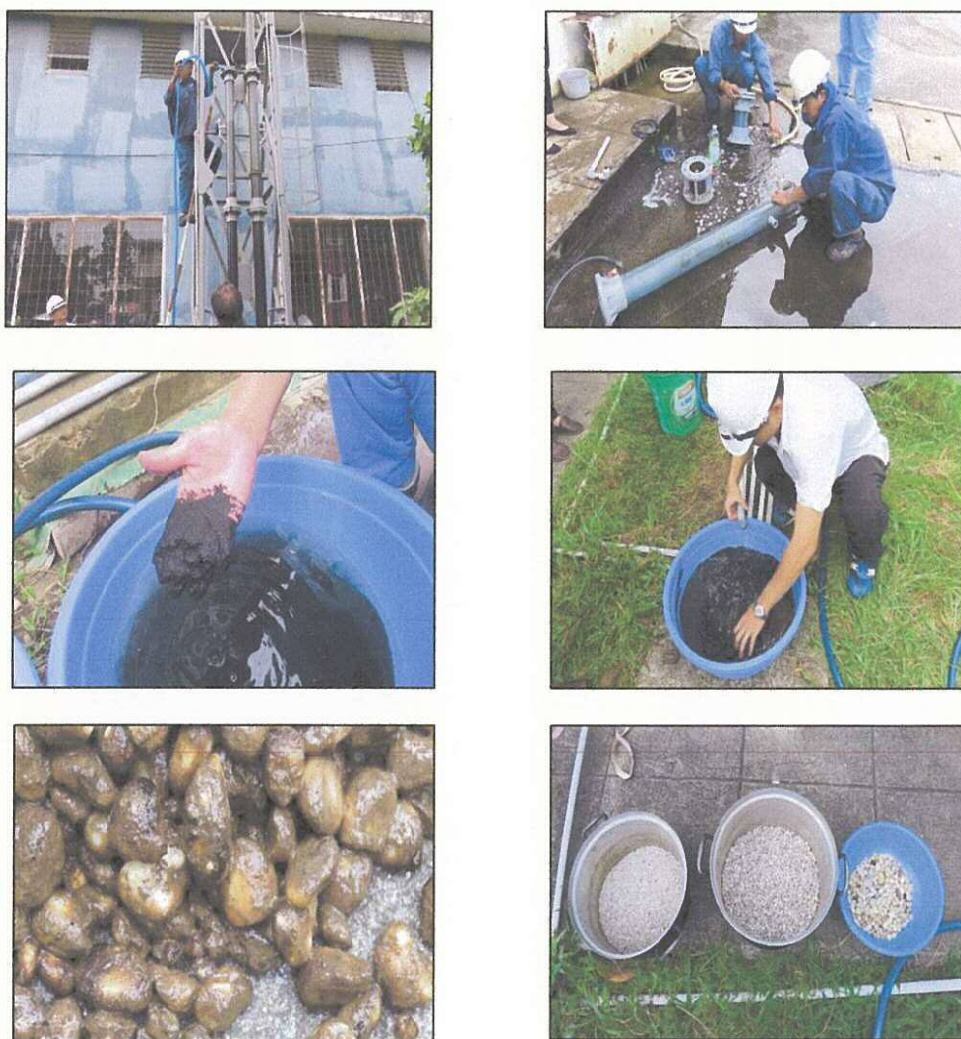


Figure 4-6 Refresh of GAC

Additionally, as a measure to further increase the fluidity of the activated charcoal, the number of holes in the distribution plate was increased from 4 holes to 15 holes as shown in Figure 4-7.

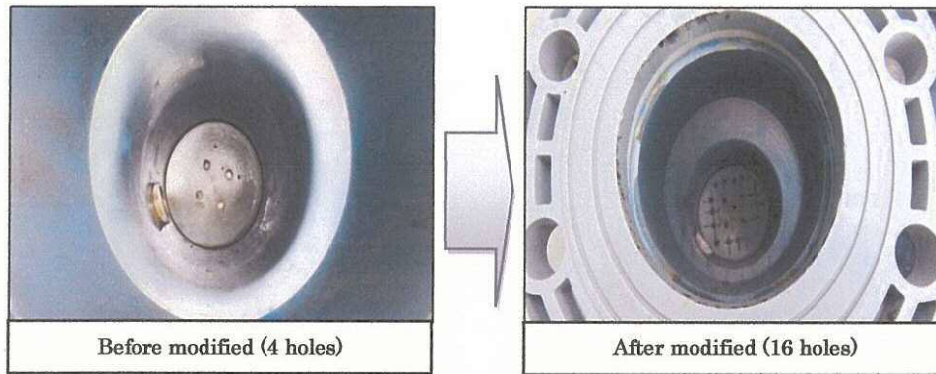


Figure 4-7 Modification of Pilot Equipment

The fluidity of the activated charcoal was improved as the results of the improvements above. Additionally, when the removal capability of U-BCF was confirmed after improvements; the removal rate of ammonia nitrogen was greatly improved in particular. (This is described in Chapter 3, Result of The Study)

5 COST ESTIMATION FOR U-BCF INTO TAN HIEP WTP

5.1 Construction Cost of U-BCF (Rough Estimation)

The current processing capacity of the Tan Hiep water purification plan is 300,000m³/day. The cost of installing U-BCF facilities with a capacity of 300,000m³/day in the Tan Hiep water purification plan calculated this time. The method of calculation used was based on previous installation results in Japan to calculate the relative capacity of the facility and construction in Vietnam was also taken into consideration.

Table 5-1 Construction Cost (Rough Estimation)

		Cost (USD)
Comission	Designing	576,761
	Sub-total	576,761
Construction	Civil Work	8,898,592
	Mecanical Work	7,098,592
	Erectrical Work	4,170,423
	Monitoring Work	754,225
	Building	554,367
	Field Work	337,183
	Sub-total	21,813,382
Administrative Fee		42,254
Total		22,432,397 (USD)

The U-BCF is a facility installed in front of the water purification plant and so remodeling of the current water purification plant is basically unnecessary. The building will be of concrete construction and so construction work would account for 40% of the overall construction fees. Additionally, this estimate is approximate and so it will vary according to installation conditions, inflation rate, etc.

5.2 Operation Cost of U-BCF

A trial calculation of costs for the operation maintenance management of the U-BCF facility in Tan Hiep will be made. The expense items for the maintenance and management fees to calculate are mainly the 3 items below.

(1) Electric Cost

Although the U-BCF is upward flow system, since it utilizes a natural down flow system, it does not require electricity for operation. Electrical costs would be for the air blower during cleaning, drainage pump, electrical valves and lighting, etc.

(2) GAC

The activated charcoal (GAC) used with U-BCF instead of using its adsorptivity, it is used as a habitat for organisms and so there is no need to replace the activated charcoal. However, it could be conceived that the washing process and wear between each other of the activated charcoal could cause erosion a little at a time. Replenishment of activated charcoal from this is estimated to be 7% per year.

(3) Mechanical Maintenance Fee

The U-BCF facilities have pump equipment and electric values installed. For problem free operations, daily maintenance is absolutely required. From past experience, 20VND/m³ can be expected.

Based on the above calculations, an annual cost of 4,272,221,430VND (205,791USD) as shown in Table 5-2 can be made in a trial calculation for operation maintenance management fees for the U-BCF. When calculated by processing volume, it will be 39VND/m³.

Table 5-2 Operation Cost of U-BCF

Contents	Volume	Number	Operation Time	Annual Electric Cost 365 days	Electric Fee for 1kw	Annual Consumption
	kw	Num.	min or hour	kwh/year	VND/kw	VND/year
1. Air Blower	37	3	30 min	20,257.5	1,929	39,077,000
2. Dust Blower	7.5	3	24 hrs	197,100.0	1,929	380,206,000
3. Discharging	11	6	2 hrs	48,180.0	1,929	92,939,000
4. Valve	0.2	9	10 min	109.5	1,929	211,200
5. Lightning	0.1	30	2 hrs	2,190.0	1,929	4,225,000
Sub-Total				267,837.0		516,658,200
Contents	Volume	GAC Life Time	Annual Rate Replenish	Annual Replenish Volume	Unit Cost	Annual Consumption Price
	m ³	year	%	m ³ /year	VND/m ³	VND/year
1. GAC	1260	15	7 %	88.2	17,750,150	1,565,563,230
Sub-Total						1,565,563,230
Contents	Volume		Annual Operating Rate	Annual Operating Volume	Unit Cost	Annual Maintenance Price
	m ³ /day		%	m ³ /Year	VND/m ³	VND/year
1. Mechanic	300,000	—	100 %	109,500,000	20	2,190,000,000
Sub-Total						2,190,000,000
Total(VND)						4,272,221,430
Total(USD)						205,791

5.3 Effective of U-BCF

When U-BCF is implemented, the Ammonium Nitrogen, Dissolved Manganese and Organic Substance in raw water will be effectively removed and reduction in the amount of chemicals added such as chlorine or flocculants necessary in the normal purification process can be expected. From U-BCF operation experience in Japan up until now, a reduction of 30% of the annual amount added can be expected. Based on the current result of pilot study, it is calculated that a chemical reduction rate would be 14%. (Utilized annual average reduction rate of ammonium nitrogen) Therefore, an annual reduction of 1,652,795,000VND (79,614USD) in costs is shown in Table 5-3.

Table 5-3 Annual Chemical Reduction Cost

Contents	U-BCF Treatment Volume	Dosage	Reduction Rate	Annual Reduction Volume 365days	Unit Cost	Annual Chemical Reduction Cost
	m ³ /day	g/m ³	%	kg/year	VND/kg	VND/year
1. PAC	300,000	24.4	14	374,052	2,976	1,113,179,000
2. Chlorine	300,000	2.75	14	42,158	12,800	539,616,000
Total(VND)						1,652,795,000
Total(USD)						79,614

If U-BCF make a significant contribution work effectively, an annual reduction of 3,541,703,000VND (170,602USD) in costs as shown in Table 5-4. This amount is the same as the operation maintenance management fees necessary for the U-BCF as described above.

Table 5-4 Annual Chemical Reduction Cost

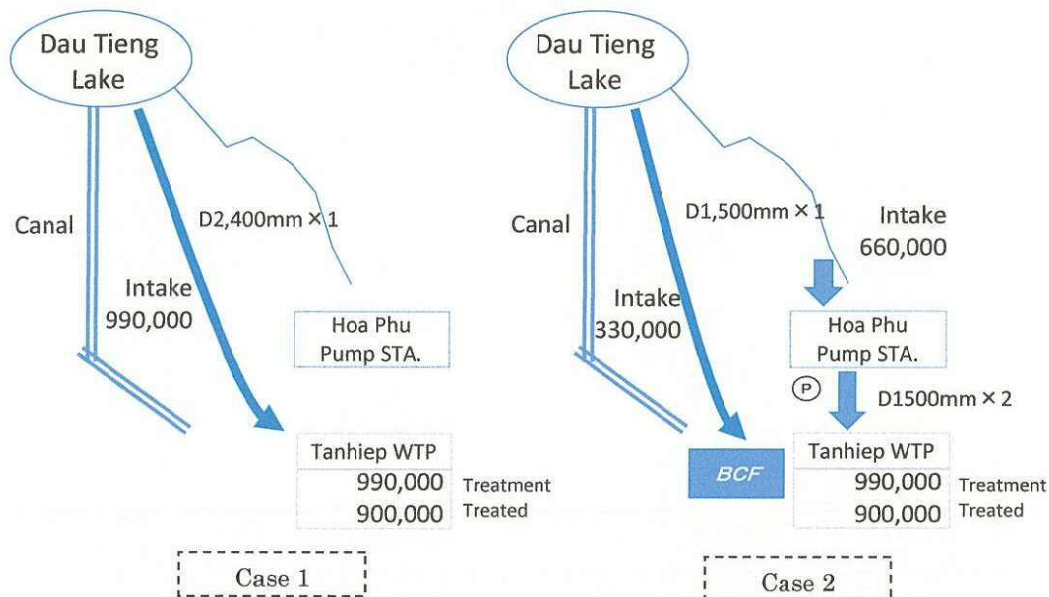
Contents	U-BCF Treatment Volume	Dosage	Reduction Rate	Annual Reduction Volume 365days	Unit Cost	Annual Chemical Reduction Cost
	m3/day	g/m3	%	kg/year	VND/kg	VND/year
1 . PAC	300,000	24.4	30	801,540	2,976	2,385,383,000
2 . Chlorine	300,000	2.75	30	90,338	12,800	1,156,320,000
Total(VND)						3,541,703,000
Total(USD)						170,602

Additionally, in order to remove NH₄, Mn and Organic Substances without U-BCF, much chlorine is necessary for this treatment, and the formation of trihalomethane (THM) in water treatment plants, has become a problem.

Through reduction of the organic matter, the value of THM contained in the supply water can also be expected to be reduced and the safety of the water improved. From the past experience in Kitakyushu City until now, trihalomethane can be expected to be reduced by about 30%.

6 COMPARISON FOR THE TWO PROJECTS

According to the Expansion Plan planned by the Saigon Water Company, the current processing capacity of 300,000m³/day is to be increased to 750,000m³/day by 2015 and in 2020, additionally increased to 900,000m³/day. It is planned that the entire volume of water to be taken for the source of the water is to be the DAU TIENG Lake where good water quality can be secured. However, since the DAU TIENG Lake is about 60km away from the purification plant, maintenance fees would cost 1,225,405,463USD (about 150 billion yen) was calculated according to a preparatory investigation by JICA in June of 2013. Case 1 is the plan to take the entire volume of water from the DAU TIENG Lake, and Case 2 is to implement U-BCF and continue to take water from the Saigon River, and compares the respective maintenance costs of both.



	Contents	Pipe	Volume	Investment	Total
Case 1	U-BCF	-	0 m ³ /day	0 mil.USD	1,226 mil. USD
	Conveyance	φ2,400×2	900,000 m ³ /day	1,226 mil. USD	
Case 2	U-BCF	φ1,500×2	600,000 m ³ /day	46 mil.USD	564 mil.USD
	Conveyance	φ1,500×2	300,000 m ³ /day	518 mil.USD	

Note: Survey in Kitakyushu Water

In Case 2, is when the current processed water volume (600,000m³/day) is taken from the Saigon River and the expansion volume taken from the DAU TIENG Lake. The total maintenance costs are compared to Case 1 and Case 2, there is a reduction of approximately 662 million USD and it can be calculated that implementing U-BCF is highly effective.

7 Conclusion

In the year from Feb. 2014 to Jan. 2015, a U-BCF pilot study was conducted at SAWACO and the effectiveness of U-BCF was evaluated in regards to the Saigon River water quality. Looking back on this pilot study, we faced various technical issues that were not expected (Described in 4. Technical issues to be found), the processing effect of U-BCF was considerably reduced and in each case, much time and expenses were spent finding the cause and planning countermeasures and it was not possible to continuously carry out the pilot study throughout the year. Operational performance by the actual equipment in the pilot study in Kitakyushu and Vietnam Hai Phong could not be understood and the new technical challenges that were discovered with this pilot study can be said to be very significant.

However, in regards to the water quality of the Saigon River, because of these issues the period that the function of the U-BCF was reduced was more than half of the testing period (1 year), and therefore at this time it can be assessed that the effectiveness of the U-BCF for the Saigon River cannot be recognized. Accordingly, it is intended that in the future, SAWACO will be strongly advised to continue the pilot study using the experimental equipment.

Additionally, many personnel from SAWACO participated in this pilot study however, the U-BCF was new technology for SAWACO and because no training or human resource educational program was implemented, the question remains if the SAWACO staff had sufficient knowledge of the U-BCF.

On December 5, 2013, in the "memorandum effective concerning the U-BCF Pilot Study" signed by the 3 parties SAWACO, K-Water and Haiphong Water, the responsibilities of K-Water is defined as follows.

To prepare necessary funding sources from the Central Government of Japan concern as follows,

- 1) Staff dispatching from Kitakyushu Water, Hai Phong Water and other engineers not belong to SAWACO (Completed)
- 2) Staff inviting from SAWACO for the U-BCF training course (one week, five staff around), in the city of Kitakyushu (NOT Completed)

However, the situation is that the training in Japan of SAWACO staff has still not been fulfilled. As a result, in order to succeed in advising SAWACO the "continuation of the Pilot Study", it is strongly advised to K-Water that the U-BCF training for the SAWACO staff is realized.