行政院及所屬個機關出國報告

（出國類別：考察、參加會議）

參加中法工業暨經濟合作會議、中比企業合作會議及考察高級淨水處理設施

服務機關：台灣省自來水公司
出國人職　稱：經理
姓　名：劉廷政

出國地區：法國、比利時

出國期間：八十九年十月十五日至十月二十六日

報告日期：九十年四月十七日

摘要

奉派參加第九屆中法工業合作會議、第十四屆中法經濟合作及第十五屆中法企業合作會議，順道考察法國巴黎之Mery-sur-Oise淨水場及比利時希魯塞爾之Tailfer淨水場。

會議主要討論電子通訊、能源、環保、交通運輸、生技、智財等領域之技術合事宜，並安排與當地廠商座談或參觀其設備、瞭解雙方之需求與可能之商機，有助於未來雙方工業與經濟之合作。

考察法比高級淨水處理設施，瞭解其由模型場試驗研究，進而辦理工程設計、招標、施工監造、試車與操作處理過程，所遭遇之困難問題及解決之對策，當有值得我國未來採行高級淨水處理技術學習與仿效之處。

目錄

一、 目的

中法工業暨經濟合作會議每年定期舉行，本（八十九）年輪由法國主辦，因議題中討論台灣省自來水公司之大高雄地區高級淨水處理場計畫之辦理情形，經濟部工業局函請公司共襄盛舉派員赴法參加會議。因國內尚無高級淨水處理場，而法國巴黎之 Mery-sur-Oise 淨水場剛新建完成日產十四萬噸飲用水之高級淨水薄膜處理場，為全球首座採用超微過濾（Nanofiltration,NF）薄膜技術成功處理地面水水源，且為規模最大之 NF 淨水場；爰此公司決定派筆者參加會議報告計畫辦理情形，同時考察該淨水場新建設施之規劃、設計、施工與操作管理之情形，以為國內興建高級淨水處理場之參考。

另我國中歐貿易促進會亦同時函請公司派員順道參加在此比利時召開之第十五屆中比企業合作會議，因悉比利時布魯塞爾之 Tailfer 淨水場刻正興建臭氧與粒狀活性碳(GAC)泸池設施中（預定二〇〇一年十月完工），與公司計劃興建設施之處理程序類似，更值得派員前往瞭解，爰派筆者順道參加會議，同時考察該淨水場目前之設計與施工管理情形，以為未來興建類似設施之參考。

二、 過程

1. 十月十五日，由中正機場搭機出發。

2. 十月十六日，抵達巴黎戴高樂機場，住長榮桂冠酒店，並即召開訪問團務會議，介紹團員與行程。

3. 十月十七日，上午隨同工業局施局長顏祥領隊之官方團團員，前往法國財經工業部參加第九屆中法工業合作會議。筆者負責報告環保議題中有關大高雄地區興建高級淨水處理場計劃辦理情形。下午隨同官方團前往法國企業行動委員會（MEDEF）參加第十四屆中法經濟合作會議，由雙方代表分別報告工業發展、投資機會、合作機會等議題，並與有興趣法國廠商座談。

4. 十月十八日，訪問團分組參訪，筆者隨同其他組參訪里爾市（Lille）之工商總會，聽取 Auchan 集團業務簡報後，參觀 Auchan Express 新設之電腦選購賣場，當場示範客戶停車點選電腦上之商品後，三至五分鐘即付款取貨之作業程序，展示其超高之服務效率與科技發展。

5. 十月十九日，由我國駐巴黎辦事處黃秘書青雲陪同參訪 Mery-sur-Oise 淨水場，與負責該場 NF 薄膜處理設備設

計與施工之公司（Vivendi/Generale des eaux）人員，包括工程部工程師 MS.Claire Ventresque 等，討論規設、招標、契約規範，施工品管、試車、操作管理與各項成本等問題，並索取相關資料，完成訪法之重點行程。

6. 十月二十日，訪問團大部團員搭機返國，參加第十五屆中比企業合作會議團員（二十五人）續留歐洲。

7. 十月二十一日，搭機飛往布魯塞爾，與我駐比代表處經濟組楊組長弘誌討論行程。

8. 十月二十二日，星期日，團員參觀布魯塞爾市。

9. 十月二十三因，隨同中國鋼鐵公司王董事長鍾渝參加第十五屆中比企業合作會議，由雙方代表分別報告經濟與科技發展、政府採購指引、合作機會與歐元之未來發展等議題。

10. 十月二十四日，由我國駐比代表處許秘書莉美陪同參訪 Tailfer 淨水場，由該場之公關 Mr.Hilaire DECREM 帶路至各項處理設施，請現場操作或管理人員解說與回答筆者之問題，包括以往興建與正興建中之臭氧與粒狀活性碳泸池之緣由，遭遇困難與解決對策等，完成訪比之

重點行程。

11. 十月二十五因，搭機經阿姆斯特丹返國。

12. 十月二十六日，返抵中正機場。

三、 心得

1. 参加中法工業暨經濟合作會議：

本次會議議題涵蓋電子通訊、能源、環保、交通運輸、生技製藥、智慧財產、工業暨技術合作等七大領域，三十二項議題，因事先作業嚴謹，各組參加人員皆熟諳議題討論內容，且法方備有二名翻譯，雙方可以本國語言發表意見充分溝通，因此會議進行相當順利；筆者參加之環保領域，議題偏重焚化爐之 BOO/BOT 計畫與工業污水處理場計畫，多由工業局第七組黃科長孝信負責報告，筆者僅負責報告有關大高雄地區計畫興建澄清湖、拷潭及翁公園等三座高級淨水處理場之辦理情形，因尚未進行至工程招標階段，因此法方未進一步討論。

至於在法國企業行動委員會(MEDEF)召開之中法經濟合作會議，主要由我方之工業局施局長、經濟部生技與製藥推動小組之廖主任怡蘭、台電之陳處長貴明，及武越夫律師等，分別報告台灣之工業發展與中法合作機會，並聽取法方代表報告投資機會，同時分組與法廠商談交換意見，惟筆者未遇見從事水處理業務之法方廠商

或代表。

2. 參訪巴黎之 Mery-sur-Oise 淨水場：

係筆者此行之主要目的，因此事先除透過我國在法之亞洲貿易促進會駐巴黎辦事處（駐法經濟組）安排參訪行程外，同時於九月底先 E-mail 予負責興建該場 NF 薄膜處理設備之 Vivendi/Generale des Eaux 公司之高級工程師 Claire Ventresque 小姐，告知筆者參訪之目的，並請其協助提供所需資料，所幸於筆者出國前夕接獲其主管 Guy Bablon 經理傳真，同意筆者於十月十九日參訪該場，並表示願親赴現場解說，上述二人確予筆者莫大之協助。

2-1. 巴黎之三座淨水場：

巴黎之自來水係由民營之 SEDIF 公司負責經營，主要由設於 Seine 河之 Choisy-le-Roi 淨水器（最大出水能力 800,000M^3/日，CMD）及 Marne 河之 Neuilly-sur-Marne 淨水場（最大出水能力 800,000CMD）供應，二場間設有大口徑之聯通管可互相支援供水。另設於 Oise 河之 Mery-sur-Oise 淨水場

原僅可出水約132,500CMD，但因其供水區北側之需水量持續成長，且Oise河仍有足夠水源可取，因此SEDIF公司決定擴建該場成可出水 340,000CMD，同時增設Marne與Oise河間之聯通管，以便支援巴黎東區之用水。

三座淨水場雖已設臭氧與生物活性碳沪池（Biological granular activated carbon ,BAC）之高級淨水處理設備，以維水質安全。但因Oise河之有機物質較Seine及Marne河多，因此Mery場之處理較為困難，出水水質不如Choisy與Neuilly場。為此SEDIF 公司決定委託 Generale des Eaux 公司辦理Mery場之擴建與改善設計、操作以及供水作業。

2.2 Mery淨水場採用NF薄膜處理程序之經過：

Oise河之原水水質如下表：

項目	最低	最高	平均
濁度-ntu	30	250	78
導電度-$\mu s/cm$	330	800	560

總溶解固體量－mg/L	150	720	435
PH 值	7.7	8.3	8.0
總有機碳－mg/L	3	10	3.9
溶解性有機碳－mg/L	3	7	3.8
磷酸塩－mg/L	0.2	0.9	0.5
Atrazine－mg/L	ND	1.0	—

另據 C.Ventresque 小姐表示，Oise 河水之總有機碳（TOC）含量每年約有 10 次達 10mg/L，而 SEDIF 規定淨水場出水之 TOC 含量不得逾 2mg/L，因此 Mery 淨水場常因無法去除 TOC 而減量出水，甚至被迫關廠。為此 SEDIF 決定於 Mery 場採用薄膜處理程序，除擬滿足 TOC 低於 2mg/L 之需求外，並期望仍有足量之鈣與碳酸氫塩（ bicarbonate)，以免水質有腐蝕性。經多次試驗 NF 薄膜可符需要，於是 SEDIF 決定先建 2,800CMD 之模型場，俾瞭解其實際性能，並為將來擴建之依據。該模型場於 1993 年完成，並供水予附近之 Auvers 鎮使用（人口約 6,000 人）。

模型場係以 Mery 場原有處理設備之出水，經砂泸與加

酸後，再經袋式泸器（bag filter）處理後，始壓入 NF 薄膜處理。模型場採二套 NF 薄膜，每套分成三段，第一段設八支壓力管，第二段設四支，第三段設二支，每支壓力管直徑 200 厘米，內設六只膜組（二套共有 168 只膜組，採用 Filmtec 公司之 NF70 薄膜），每套可出水 1,400CMD，每噸出水耗電量低於 0.7KWH，出水水質之有機物質與三鹵甲烷前驅物質（THMFP）含量均甚低，農藥亦可去除，無餘氯味與良好之味道與軟水，滿足了 Auvers 之用戶需求。

雖然模型場証實 NF 薄膜優點甚多，惟亦有相當多之操作缺失，例如袋式泸器之微過泸（Microfiltration ,MF）袋須經常更換，耗費甚大，因此 NF 薄膜之前處理程序必須重新設計，改採微細砂（Microsand）以及高分子凝聚劑（Polymer）之混凝沈澱，中間臭氧處理，以及雙層泸料（無煙煤及泸砂）過泸等，俾使其出水之淤泥指數（Silt Density Index, SDI）低於 3，每毫升水中，大於 1um 之顆粒數在 200 左右，鋁與鐵塩之含量低於 50 等，以避免薄膜之阻塞。此外，NF70 薄膜之出水需以昂貴之再礦化處理（remineralization）；始適宜送入配水系統；另所加之 HCL

對場內之不銹鋼管，與配水管網有腐蝕之虞，顯示宜採可通過較多硬度與適用 H_2SO_4 之薄膜；經多次試驗後決定改採 FilmTec 之 NF200B 薄膜，使其出水之鈣含量由原低於 20mg/l（以 caco3 計），提高至 100mg/l 以上，鹼度由原低於 20mg/l（以 caco3 計），提高至 80mg/l 以上，導電度由原 40，提高至 380，以降低出水之腐蝕性。此外 NF200B 對有機物之去除率仍可維持 90%以上，有效去除微生物，降低能源成本，薄膜壽命最少五年以上，………等，因此實場之擴建最後決定採用 NF200B 薄膜。

NF70 與 NF200B 之特徵比較

	NF70	NF200B
Thickness（厚度）	1,500-2,000A	200A
Composition（合成物）	Polyamide	Polypiperazine
Microporous support	Polysulfone	同左
Support	Nonwoven polyerster	同左
Feed Spacer	28-mil polypropylene	同左
	9 strands/in	同左
Permeate spacer	10-mil tricot,48wales/in	同左

	55 courses/in	同左
Number of leaves Per module	30	同左
Effective membrane Suface	37m2（400sqft）	同左

2.3 Mery 淨水場現況：

本場現有二種處理程序同時操作，原有者採用生物處理程序（Biological process），最大出水能力可達200,000CMD，惟平常僅出水30,000CMD。原水由Oise河先抽入儲水池滯留二天，再抽入快混池添加聚氯化鋁（PAC），經膠凝、沈澱、快沪處理後，添加臭氧及H_2O_2，再加氯消毒後，流入混和池與新設NF處理程序之出水（140,000CMD）混合，最後流入清水池抽送供水區使用。

新設之NF薄膜處理程序1996年動工，1999年完工，係依模場試驗結果設計，包括前處理、NF及後處理程序。前處理程序之處理能力為178,000CMD，原水由儲水池抽入後先加硫酸調整pH至7左右，再加聚氯

化鋁及高分子助凝劑(陰離子型)，經二組 Actiflo(內設傾斜管)澄清後，添加 0.5 至 1mg/L 之臭氧處理，再加約 5mg/L 之聚氯化鋁，即以十組雙層濾料(無煙煤及濾砂)濾池過濾，濾水流入中間水池備供 NF 過濾用。原水儲水池濁度平均 20.6NTU，過濾水濁度平均低於 0.05NTU，大於 1.5um/mL 之顆粒數平均僅有 22，總菌落數（Total coliforms/100ml）平均 0.4，溶解性有機碳（DOC）平均 2.1mg/L，顯示經前處理後之水質相當良好。

在進行 NF 過濾前，進水先加 2mg/L 之抗垢劑(Anti-scalant)，再以低揚抽水機送入八組前置過濾器(pre-filter)，以 6um 之濾率去除殘餘之大顆粒。每組過濾器內設 410 支長 60 英吋之匣式濾管，可處理 20,880CMD 水，八組共可處理 167,000CMD。每組過濾器每 24 至 36 小時自動以 5bar 之壓力水反沖洗一次，約每 20 天再以藥劑清洗管中積垢，以維持其正常功能，並期匣式濾管可使用五年以上。經此處理後，雖總菌落數及 DOC 含量未減，惟大於 1.5um/ml 之顆粒數平均降

至2.3，SDI平均僅2.8，已適於進行NF薄膜處理。

NF薄膜處理程序共有八組，每組分成三段，各有108、54及28支壓力管，以確保可處理每段進水量之半;每組共有190支壓力管,八組共有1,520支壓力管。每支壓力管內有6只螺旋捲膜組（Spiral wound module)，使用美國DOW Filmtec公司特製之NF-200薄膜，每只膜組之有效過泸面積約為40平方英呎，因此整場之9,120只膜組共有364,800平方英呎（33,890平方公尺）之有效過泸面積！

進水視水溫以8至12bar之壓力，送入NF薄膜之第一段過泸，其濃縮液再進第二段過泸，依序再進第三段過泸，各組可產水17,500CMD，八組共可產水140,000CMD，回收率穩定維持在85%左右。出水水質之TOC含量約僅0.18mg/l，BDOC 農藥與其副產物皆低於偵測極限（50nano g/L)，惟碳酸氫塩含量仍維持在30~60%左右，無需再進行再碳化處理（recorbonisation)，鈣與鎂含量亦維持在20~55%左右，水質顯較模型場為佳。

每組 NF 薄膜處理程序設有線上顆粒計數器（On-line particle counter）及導電度偵測器，與 55 只控制閥，配合電腦自動控制系統（又稱 Level 3 系統），整場無人亦可自動操作，隨時可查知某組薄膜之清潔或污濁狀況，如某一薄膜需清洗時，操作人員可按鍵依設定之程序清洗，亦可依其自訂之方式清洗（例如改變清洗藥劑之濃度或浸泡時間），且可存於電腦中供日後使用，清洗完成後電腦即列出報告，俾瞭解其效率與成本。

經 NF 薄膜處理之沪水，最後流入設於屋頂之八組脫氣塔（degassing tower），以去除沪前添加抗垢酸劑所產生之二氧化碳，再以紫外線（UV reactor）消毒後，流入混和池與生物處理程序之出水混合。因 NF 薄膜之沪水仍具有腐蝕性，且約佔混合水量之八成，須再添加氫氧化鈉調整 pH 值，使其碳酸鈣飽和指數達到正數，以穩定該場出水水質。

整場計有十二棟建築物，均以基樁及預鑄墻興建，外牆採綠色或白色或用玻璃牆，以融入周圍之環境，相

當環保與美觀，屋內通風或空調情況良好，噪音控制亦佳，通道寬敞易於維修，各項設施多採線上偵測器（超過450個）與光纖電腦系統，達全場可自動化操作之境界，相當新穎與現代化。

以1997年幣值計算，不含20.6%之加值營業稅及土地與基礎費用，前處理設備之造價約合4,500萬美元，NF薄膜與後處理設備約合4,850萬美元，如計入生物處理程序之改造費用，全場造價高達1億3,500萬美元（約新台幣44億元），由SEDIF公司分五年投資。操作14萬噸NF場之成本，如包括攤銷投資經費（以20年、年利率8%計）、電費（每度0.048美元）、藥品與維修費用等，每噸出水成本約為0.3美元（不含營業稅）。但以NF薄膜處理水所增加之費用，估計所有售水之成本僅增加0.12美元（不含營業稅），因此Mery場之擴建並未導致水價之調升。（按目前巴黎之水價每度約為新台幣36元）。

3. 參加中比企業合作會議：

會議在比利時工程工業聯盟（Fabrimetal）總部舉

行，由其執行總裁 Mr.Philippe de Buck van Overstraeten 與我方中鋼公司王董事長鍾渝共同主持，開幕式後由比利 Fortis 銀行市場研究處長 Mr.Jean Gennart 與我方常在國際法律事務所常專門委員越夫專題報告，接著簽署聯合聲明。下午續由比利時 Esco Transmission 與 Transurb 公司代表報告後，舉行面對面會談，筆者與 Donaldson 公司之 Mr.Verstraeten 面談，該公司專長於引擎之過沪系統、排氣系統、空氣污染防治及各類過沪器等，惟能使用於自來水設施之機會不高，因此面談短暫時間即結束。

4. 參訪布魯塞爾之 Tailfer 淨水場：

係筆者比利時行之主要目的，事先已悉該淨水場正興建臭氧與粒狀活性碳之高級淨水處理設施中，因此透過中歐貿易促進會與我駐比利時代表處安排參訪行程。十月二十四日由代表處經濟組商務秘書許莉美小姐駕車送筆者至該場，由布魯塞爾水公司（Compagnic Intercommunale Bruxelloise des Eaux ,CIBE）之公關 Mr.Hilaire De CREM 帶領參訪，並由水廠人員簡報。

CIBE 成立於 1891 年，係比利時最大之自來水公司，每天供水 40 萬噸予布魯塞爾及其南部之 38 個城市共約 210 萬人使用，其水源 60%取自地下水，40%取自地面水。地下水取水方式包括開鑿隧道引取滲流水，在地下水位以下設集水暗渠取水，以及開鑿深井抽水等，因地下水水質良好，幾乎無需再過沪或處理，添加少量之氯以維輸水安全，即可供飲用。少數鐵含量較高之地下水，則設快沪池處理後再供水（例如 Vedrin 淨水場處理 3 萬 CMD）。地面水源主要取自於 Meuse 河，由 Tailfer 淨水場處理後，供工業與民生用水。

供水區內分成超高區、高區、中區與低區等四區，以逾 500 公里之輸水渠、221 公里之送水管線，及約 4,100 公里之配水管線，以及 4 座加壓站、2 座平壓塔、13 座配水池（蓄水量高達 387,000 噸），維持穩定之供水。管線材質包括鋼管、水泥管、鐵管及塑膠管等，依水質、土壤與壓力情況而選用。

Tailfer 淨水場位於布魯塞爾東南方約 100 公里之 Meuse 河畔，1969 年動工興建，1973 完成第一座

65,000CMD 處理設施，1976 年完成四座共 260,000CMD 之處理設施，1993 年增設臭氧前處理設施，2000 年完成第二座臭氧設備，目前正興建粒狀活性碳沪池，預定 2001 年 10 月完工啟用，全場面積達 20 公頃，尚保留相當多空地與林地。

原水由 Meuse 河底以二條水管引入抽水站，先以 2mm 篩初沪後，再抽送至前臭氧接觸池處理，臭氧加藥量平均 1.7mg/L，接觸時間約 8 分鐘，隨後流入快混池，添加硫酸鋁、硫酸、活性矽砂及粉狀活性碳等藥劑後，經混凝、沈澱、決沪後，再以後臭氧接觸處理（去除微生物、味道與臭味、色度及氧化有機物等），最後加少量之次氯酸鈉及苛性鈉，以穩定水質後流入 3 萬噸清水池，以抽水機送供水區使用。

所有處理設施均設於屋內，沈澱池採用法國 Degremant 之脈動式，快沪池亦採同廠之 Aquazur 型，另設有四台 3,500KVA 之發電機，停電時仍可充分供電，並有完善之水質檢驗設備與人員，供水品質與操作管理良好獲得 ISO 9002 品質認証。為符合日趨嚴苛之歐洲共

同體飲用水水質標準規定，與徹底去除Meuse河原水之農藥，除正新建生物活性碳泸池（BAC）外，原有之快泸池亦逐池改建成BAC泸池，以替代以往之物理化學處理程序；新設泸池深約5公尺，池底使用不銹鋼集水管，水管廊內全部使用不銹鋼，組裝品質精良，各種管道、電纜槽與控制儀器架設井然有序，顯示設計與施工品質一流值得參採。

CIBE公司目前員工數約1,400人，供水區平均每人每日用水量僅有112公升，或因節約用水宣導成功或水價高昂之故，用水量仍在逐年降低。水費係依水表計數收費，每噸水最低57比利時法郎（約合新台幣40元），惟每人每年用水量超過15噸時，超過部份則以87比利時法郎計收；另外污水部份，布魯塞爾區每噸收16比利時法郎，Franc地區每噸收25比利時法郎，水費（自來水及污水費）相當昂貴。惟據Mr. Hilsaire De CREM表示，上述57比利時法郎中，生產與管理成本各為27及30比利時法郎，水價尚屬合理，目前尚無調價計畫。

臨行時Mr. H. De CREM致贈筆者二卷介紹Tailfer

淨水場與 CIBE 公司如何保護水源潔淨、取水、淨水、送配水等之宣導錄影帶，內容相當具說服力，畫面與配樂亦頗佳，顯示 CIBE 司頗重視公關，值得吾人學習仿效。

四、結語與建議：

目前歐、美、日先進國家均積極發展高級淨水處理技術，近年來更投入大量之人力與經費興建大型實場，尤其採薄膜處理程序替代傳統之過技術，以去除微量之污染物質，大幅提升出水品質最為醒目。惟因各地區之水質情況不同，目標水質亦不盡相同，故仍須進行長期之模型場試驗，就各種可能之處理程序進行評估，方能擇定最適宜之處理程序。自來水公司在 88 及 89 年委託成大環工所，在澄清湖淨水場進行二年之高級淨水處理模型場試驗，曾就前、後臭氧處理、粒狀活性碳沪池、流體化結晶軟化處理以及各種薄膜處理程序（MF、UF 及 NF），進行多達十幾種處理程序之研究，獲得相當豐富之資訊，當有助於辦理大高雄地區澄清湖、拷潭及翁公園淨水場增設高級淨水處理程序之選擇。

以下謹就此行心得建議幾點供參考：

(一)加強保護水源，減少污染與淨水處理之困擾。

(二)取用受污染之水源，即需盡速改善或增設高級淨水處理設施，以維用戶用水安全。

(三)引進高級淨建處理程序前，須進行長期之模型場試驗，確實評估可行之處理程序後，方宜辦理實場工程，以免完工後成果未盡理想。

(四)引進高級淨水處理程序時,宜同時培訓各種高級專業人員，俾可順利操作先進設施，達到提昇水質、降低成本與經久耐用之目標。

(五)目前各先進國家常舉辦高級淨水處理技術研討會,並參觀其先進之處理設施,各國皆派龐大之成員參加，以擷取新知與經驗,惟我國參加成員多屬學術機構，產官方面宜多派員參加，始能獲得整體之成效。

(六)先進國家之水價為國內之數倍,新建或改建高級淨水處理設施遊刃有餘,甚至無需調升水價亦能維持正常操作,反觀國內需由政府補助或投資經費始有餘力辦理工程，惟完工後昂貴之操作管理費用，如無合理之水價支撐或政策性補助,恐易造成事業單位鉅額之虧損，而影響高級淨水處理之普及與進展。

(七)薄膜處理技術近年發展快速,造價與處理成本大幅降低，未來替代傳統處理程序之機會漸大，國內廠商宜

及早投資研發，以爭取商機並符國內之需求。

附件一：

第九屆中法工業合作會議議程

9th FRENCH-TAIWANESE INDUSTRIAL COOPERATION MEETING

PARIS, Tuesday 17th October 2000

AGENDA

I. OPENING (9:00 - 9:20)

II. INDUSTRIAL TOPICS

1) Telecommunications, electronics & computer science (9:20 - 9:40)

2) Energy (9:40 - 10:00)

3) Environment (10:00 - 10:20)

Coffee break (10:20 - 10:50)

4) Transportation (10:50 - 11:10)

5) Other sectors & new projects (biotechnologies, general cooperation including chemistry) (11:10 - 11:30)

III. PROMOTION OF FRENCH IMAGE (11:30 - 11:40)

IV. CONCLUSION (11:40 - 12:00)

STATUS REPORT
OF THE 9TH INDUSTRIAL COOPERATION CONSULTATION MEETING

1. ELECTRONICS AND TELECOMMUNICATIONS

1.1 Software, Multimedia and Internet

In the software industry, Taiwanese companies raised the following suggestions for further action plan:

1. Establish a formal information exchange and contact window dedicated to accelerating cooperation between software related companies of the two countries.
   SOFT5 (Software 5-Year Development Office) of III (Institute for Information Industry) and CETRA (China External Trade Development Council) are working together on a research project to study the feasibility of exploring the European software market. CETRA cooperates with CFME-ACTIM to organize the program of the Taiwanese experts. This project is expected to help Taiwan's software companies find more opportunities for business and cooperation with French companies.

2. Organize a delegation of Taiwanese companies to attend major trade shows in France, such as the Milia Multimedia Show in February.
   Supported by IDB (Industrial Development Bureau), MOEA, and CETRA, III-SOFT5 organized two delegations of 10 major multimedia companies to participate in exhibition in the Milia Show of Cannes in 1999 and 2000. Over 50 companies also joined the show. This helps the companies export/import product to/from the European market.

3. Organize training, workshops and seminar programs for exchanging experience and enhancing creativity in designing software products.
   The involvement and assistance from FIT and other related French agencies would be the key factor for success in organizing the above activities. Multimedia and Internet related topics will be popular for Taiwanese companies.

4. Promote and organize business events periodically to encourage cooperation between the two countries.

CFME-ACTIM organized a delegation of about 10 companies and visited Taiwan in June, 2000 during the World Congress IT. III-SOFT5 also helped arrange appointments with Taiwanese companies in accordance with French companies' interests. III-SOFT recommends organizing a workshop for exchanging views and forming partnerships in multimedia software to accelerate the cooperation between companies from both sides. III-SOFT5 also seeks the assistance of CETRA-Paris and CFME-ACTIM.

The current cooperation projects focuses on multimedia software industry. The Taiwan side suggests extending such cooperation to other areas such as Internet, e-Commerce and co-development project, etc.

Since this industry is fast-evolving, the French side urges both sides to promptly identify new direction for mutual cooperation, including, in particular, the Internet.

1.2 Testing

The French company NCE, from Sassenage, has completed the installation of new equipment to fully comply with Taiwanese specifications for electron magnetic compatibility (EMC) testing. The company is going to apply with the Bureau of Standards, Metrology and Inspection (BSMI) for its approval as a designated EMC laboratory. In order to promote the development of electronic exchanges, NCE hopes that the Taiwan side assists NCE in the application.

Based on the "Operation Guidelines for the Approval and Management of Designated EMC Laboratories" of BSMI, qualified manufacturers can assign a local agent to apply for a BSMI-designated laboratory to perform EMC testing if they have been accredited under ISO/IEC Guide 25 procedure and are equipped with testing facilities. BSMI suggests that NCE check the website of BSMI at www.bsmi.gov.tw for relevant information.

2. ENERGY

The French side states that French companies have developed world-ranking expertise in the field of energy supply, and French gas companies are also eager to work with companies in Taiwan for the supply of gas. Closer cooperation between the two sides can help Taiwan meet the increasing demand for electricity. The French side suggests that both sides follow this sector closely.

The Taiwan side refers to the government's policy to liberalize the energy sector, in particular, the oil and power industry, and to encourage the use of LNG in Taiwan. Noting the advanced status of the French industries in these areas, it is hoped that both sides can work closely together.

2.1 Lungmen nuclear power plant

The engineering, design and integration work of Balance of Plant (BOP) portion of Lungmen Nuclear Project Units 1 & 2 will be performed by Taiwan Power Company (TPC) and Stone & Webster. The BOP equipment to be procured by TPC includes four categories :

1. Structural and architectural equipment;
2. Mechanical equipment;
3. Electrical equipment; and
4. Instrument and control equipment.

Each bid package for foreign procurement of BOP equipment (approximately 60 bid packages in total) is conducted through an international tender by inviting the qualified suppliers in accordance with the established bidder's pre-qualification (PQ) process. The public notice of bidders' qualification will be announced in the ROC Government Procurement Gazette.

The French side expresses its willingness to maintain in-depth contacts with the Taiwan side in the fields of nuclear power equipment and classic thermal power plants.

French companies are sincerely welcomed to be in close contact with TPC.

2.2 Nuclear fuel cycle services

The French company Cogema, which signed in December 1998 a long-term enrichment services contract with TPC, has two main objectives for 2001: to sign long term contracts for natural uranium supplies and conversion services; to continue the promotion of back-end services for TPC's nuclear spent fuels for which it hopes that the feasibility study, last year completed by the Institute of Nuclear Energy Research, will now be quickly reviewed by TPC. The French side is willing to cooperate in these fields.

Regarding the procurement of natural uranium and providing dry storage of spent fuels, TPC is glad to have the opportunity to cooperate with Cogema. However, such purchase must follow the government's procurement regulations.

2.3 Tatan power plant and LNG terminal in Northern Taiwan.

The first Unit of Tatan power plant is scheduled to be commercial operation in early of 2003 to help relieve the electricity shortage in northern Taiwan. Bidding process for power generating equipment of the plant and gas supply through northern LNG receiving terminal are under progress.

TPC published a tender announcement and issued bidding documents for procument of natural gas for the Tatan power plant on March 14, 2000, followed by a revision of bidding documents on July 28, 2000, with the bid due date on November 30, 2000. The procurement of natural gas will be conducted in a fair and transparent manner and strictly in accordance with the ROC Government Procurement Law.

The French companies who are interested in participating in the natural gas supply as well as the LNG receiving terminal project are tender of natural gas supply and/or to approach local companies to secure the opportunities for technical cooperation for LNG receiving terminal project.

Total-Elf-Fina, the newly established 4th largest integrated oil gas company in the world has been pursuing this project for several years through discussions with concerned authorities and local partners.

Total-Elf-Fina strategy is to form a strong alliance with major Taiwanese partners to:

- invest and participate in the development and construction of the Northern Terminal and
- supply LNG to the terminal from Total-Elf-Fina's Yemen LNG project.

Other companies are greatly interested in investing in gas-fired Independent Power Plant.

2.4 TPC 6th Transmission / Substation Project.

The 6th transmission/substation project of TPC covers the construction of new/expanded substation and the installation of high voltage transmission lines within the next 5.5 years. The total project budget reached to around NTD 460 billion.

The 287 new/expanded substations include 29 EHV substations, 12 primary substations and 246 distribution substations. The high voltage transmission lines include 799 ckt-km of 345kv overhead lines, 52 ckt-km o f 345 kv underground cables, 1142 ckt-km of 161kv overhead lines, 1140 ckt-km of 161kv underground cables, 292 ckt-km of 69kv overhead lines and 236 ckt-km of 69kv underground cables.

TPC's Transmission and Substation Projects Department (TSPD) is responsible for the implementation to the completion of this 6th Transmission/Substation Project including the bid process for the construction/installation of substation packages or transmission lines. In principle, each bid package will be a turnkey basis and the qualified local companies will be the prime bidders and all the bid process will be handled in accordance with the ROC Government Procurement Law requirements. Any French company who is interested in participating in this project is welcome to approach local potential prime bidders for any and all activities of the bid process.

French companies, notably EDF, Schneider Electric High Voltage (which has a license agreement with Tatung) and Alstom (license agreement with Fortune Electric Co., both will form a company, selling GIS heavy electric products) are interested in participating in this plan.

3. ENVIRONMENTAL PROTECTION

3.1 Environmental Cooperation Projects

Two environmental co-operation projects have been carried out in 2000, both in France and in Taiwan, in the fields of water quality and regulation :

- Wastewater Treatment (one week visit in France by Mr. Hung-Teh TSAI on May 2000);
- Marine Pollution Control technologies (workshop held in Taipei);

Four or five more cooperation projects will be proposed for year 2001 as follows:

1. Air Quality Monitoring Network Introduction (a visit in France by an expert from EPA followed by a visit in Taiwan by a French expert).
2. Studies on French Global Climate Change Policies (visit French related personnel).
3. Studies on new waste treatment technologies and waste treatment regulation (visit in France).
4. Infopol Seminar on marine pollution in France in July (invitation for one person).
5. Environmental Impact Assessment (French experts in Taiwan).

3.2 Seminar on Environmental Technologies

A seminar on environmental technologies was successfully organized by the Agency for the International Promotion of French Technology and Trade ¡]CFME-ACTIM¡⊥ and the French Trade Commission in Taipei in 1998. The workshop was co-sponsored by the Environmental Protection Administration (EPA) and the IDB.

A follow-up seminar will be organized on December 7, 2000 in Taipei. The EPA and IDB will again jointly sponsor this event.

As EPA agreed upon during our meetings, a workshop on Public Private Partnership and Delegated Management will be organized on December 8, 2000 in a conference room provided by EPA.

The French side will provide EPA and IDB with a tentative program as soon as possible and is waiting from EPA and IDB a list of staff and private local companies to be invited.

3.3 Incineration Plant BOO/BOT PProjects.

BOT/BOO approaches have been adopted to encourage private sector participation in construction of incineration plants since 1997. French companies are interested in these projects. The experience and efficiency of French companies can be of great benefit to Taiwan. For instance, Ta-Ho Environmental & Technical Services Co. Ltd., a joint-venture between CGEA (Vivendi) and Taiwan Cement Co., were awarded operation and maintenance contracts for 3 waste to Eenergy plants in Shulin, Taichung and Chiayi. 14 Other BOT projects, which are subsidized and supervised by the EPA and implemented by the local government, will be awarded soon. Alstom will support Ta-Ho Environmental & Technical Services Co. Ltd. as the engineering and procurement contractor for some plants.

The Taiwan side welcomes French companies to participate in these projects. The EPA will provide related regulations, guidelines and contract samples. French companies are welcomed to contact the Bureau of Incinerator Engineering of EPA or local environmental agencies for further information.

The bidding process of four BOO/BOT plants has been completed. The remaining plants will be opened for bidding soon.. In addition, in order to meet the need of industrial waste disposal in the industrial parks, the government's policy is to encourage the establishment of industrial waste incinerators in industrial parks.

Several companies are committed to the incinerator construction program. Vivendi, Environment S.A. (instrumentation for an industrial and household waste incinerator), Lab S.A. (post combustion air quality control), Europlasma S.A. (fly ash treatment), Space Architecture and Alstom (engineering procurement and construction contractor for the Nantu project).

The French side adds the following comments:

The national waste management program is set up by the EPA, and implemented by local governments through public tender offer in accordance with the Government Procurement Law, which is recently promulgated by Public Construction Commission (PCC), namely 15 BOO /BOT waste incineration projects, 9 long-term operation projects of waste incineration plants.

The implementation status of each program is far from what is originally expected by the EPA. Up to June 2000, the progress of these 15 projects (initially supposed to be subcontracted during two years, i.e. 1998 - 1999), is as follows :

- 3 projects have been awarded. For Taoyuan North Incinerator BOO project, 3 consortia passed qualification review, Hsinyu, Ever Fortune & CTCI and Ta-Ho.

- 3 projects have been issued, then cancelled due to the reasons not attributable to bidders and will be re-issued at a later date unknown, i.e. Nan-tou project (Ta-Ho with Alstom), Miaoli project (Ta-Ho with Ansaldo Volund), YunLin project (Ta-Ho with Alstom)

During the past two and half years, Ta-Ho has communicated comments either in writing or verbal discussion with EPA and the local government several times in order to discuss the feasibility and fairness of the tender documents, such as price formulae.

Some newly issued laws (e.g. Government Procurement Law, BOT Law) have provided a better legal framework for BOO / BOT projects. However these new laws and its relevant administrative regulations are not precise enough to set up fair and autonomous game rules. These laws use the words such as "can" or "may" which leave a lot of room for the discretion of local authority and, at the same time, a lot of uncertainty.

Due to insufficient information, local government has difficulties in implementing the EPA program properly and accordingly. In case of any disputes arising during the project execution of the local government, the EPA / Public Construction Commission should provide effective solution or rectify the policy in time. These projects are directly linked to urban development program and local residents. It is noticed from the recent projects that many Environmental Impact Assessments (EIA) are not examined in a professional manner due to the following reasons which result in important delay of all BOO / BOT projects.

- Due to decentralization policy, the EIA of large-scale incineration plant is now reviewed by an EIA committee of local level, instead of EPA level. The EIA committee, lacking experience, has raised questions, which are not related to the relevant professional expertise.

- The EIA Law allows the EIA committee to impose on bidder/ developer requirements beyond the EIA Law. Then it happens that EIA committee requests bidder to commit to something which is not required by law, or to a standard, which is more stringent than national or international environment standard, or which is not practically feasible.

- The professional comments of EIA committee are not fully respected by county/city councilors: the attendance of county / city councillors in ELA review meeting affects the independent position of EIA committee.

- The members of the EIA committee are assigned by the local government. Therefore the attitude and policy of the local government will affect the comments of EIA committee.

With regard to the delay in BOO/BOT incineration plant projects, the Taiwan side explains that it was the result of various events. For example, the lack of BOO/BOT experience leads to the delay of Taitung project. Since the incineration plant is the first BOO/BOT project carried out by the Taitung County, the county government has little experience in reviewing the proposals and spent a long time to finish the process. The local government has completed the review and awarded the bid this August.

Among projects that have been issued but canceled latter, the Nan-tou Project was called off for failure to pass the EIA and Yulin project was canceled for getting new site for the plant. The proposal reviewing process for Miao-li project was canceled for inability to obtain the land.

To improve the implementation of the BOO/BOT incineration plant projects, the EPA will communicate with local governments and help them conduct the bidding process more smoothly.

With regard to the French side's comments related to the EIA of BOO/BOT incineration projects, the Taiwan side's response is shown as follows:

5 Since bidders/developers need to apply for a permit related to BOO/BOT incineration project from the local government, the EIA review committee of the local government is responsible for the EIA review of the project according to the EIA Act and its Implementation Rules. As the EIA Act came into effect on 30 December 1994 in Taiwan, the local government and its review committee have accumulated much review experience of EIA projects by now. We believe that the EIA review of the local government is impartial and objective.

6 The difference between the EIA Act and other environmental protection acts is that the EIA Act mainly takes into consideration the carrying capacity of the environment, resources sustainability and the prevention of any environmental damage. The environmental standard set by EIA review therefore is generally more stringent than other environmental standards if further protection of the local environment is necessary. Many countries have similar requirements as those of Taiwan.

7 According to the EIA Act, at least 2/3 of the member of EIA review committee should be composed of experts and scholars. The purpose of this provision is to assure neutrality and objectivity of EIA review, and shield it from political interference. In terms of the EPA's implementation, we believe that the purpose can be achieved.

8 The concerned issues related to EIA will be taken into account if the EPA plans to revise EIA Act. The EPA will also actively coordinate and communicate with local governments on EIA affairs.

Ta-Ho was awarded on September 22, 2000 the BOO contract of the Waste To Energy plant for 20 years in Taitung County.

3.4 Water Treatment Plants.

The Construction and Planning Administration, Ministry of Interior, asked TWSC (Taiwan Water Supply Corporation) to plan for the improvement of water supply systems in Kaohsiung Metropolitan Area. This project covers three water treatment plants in Cheng-chin Lake, Kao-Tar and Won Park.

Through tough competition, the consulting group teamed by Sinotech (domestic company) and CDM (U.S. company) was awarded a contract for the planning work on Oct. 27, 1999. Six months after Sinotech and CDM proposed an integral improvement plan to TWSC. Based on the plan, TWSC will propose an implementation plan to the central government by the end of June, 2000. After acquiring the approval from the central government, TWSC will carry out the implementation in four years. French companies follow closely these projects.

5.1 Industrial waste treatment plants

Tender documents will be issued next year by IDB (7^{th} Division) on a to be decided BOO or BOT construction project of an industrial wastes treatment plant in Changbin Coastal Industrial Park. Solidification technologies and landfill disposals will be included as well in the bid.

Amount of wastes will be guaranteed to the contractor (the goal would be 30 % of the average 1.5 million tons of hazardous wastes produced per year in Taiwan and 20 % of the 20 millions tons of industrial wastes).

IDB needs assistance to prepare the tender documents next year. They have been particularly impressed by the plant made in South Korea by the French company Sarp Industrie.

The IDB adds the following comments:

To facilitate speedy establishment of a comprehensive hazardous waste treatment facility in the country, the IDB plans to implement a BOO or BOT construction program for a facility with an estimated capacity of 300-500 tons/day to be sited in the Changbin Coastal Industrial Park in Central Taiwan next year. Current plan for this facility may also include the construction of a non-hazardous industrial waste treatment plant in the same program.

To help the IDB implement the program, this Bureau will contract a consultant company to prepare the tender documents and enable the project to go through the EIA procedure before the bidding of the construction takes place. We sincerely welcome reputable French firms to provide information and advice so we could be more informed in preparation of planning tasks such as tender documents and EIA.

5.2 Ren-Wu Refuse Incineration Plant

Swire Sita Waste Services Limited, a Franco-British leading waste management company, headquartered in Hong Kong, has been awarded on June 30, 2000 with a 20 year operation and management contract for the Ren-Wu Refuse Incineration Plant in Kaohsiung County of Taiwan with full responsibility.

However, the French side has to convey complaints from this company about reportedly unethical requests and direct threats coming from local organized crimes, including pressures to hire undesirable employees or to intervene illegally into their daily operations, and even racketeering.

This is extremely negative for Taiwan's reputation and foreign companies' operations. It will discourage well-known international contractors with optimal technology from entering the Taiwan's environmental market.

The French side hopes that Taiwan's authorities will take Swire Sita Waste Services Limited's deep concerns into account and strongly suggest the Taiwan's authorities to take appropriate measures to prevent such actions from happening.

The IDB adds the following comments:

In his letter replied to FIT dated July 26, 2000, Administrator Lin of EPA asked the French side to provide more details about the crimes and he would inform the pertinent prosecuting agency to investigate the case after receiving the details and gaining a better understanding. Administrator Lin also assured that all the information would be kept confidential. We, however, have not yet received any further information from French side since then. Since eliminating of such crimes is one of the main agendas of the new government, we also suggest the company file the complaints to the local office as well.

5.3 Tredi's application for operation license

Tredi's activities in Taiwan date back to 1991 with exports of PCB wastes to Tredi's plant in St. Vulbas, France. A branch office commenced business in 1995, with procurement of their first EPA License in 1997. Since then, three more subsidiary companies were formed to build and operate treatment plants in Taiwan. The Tredi group will open its new TaFa county PCBs treatment plant and is now at an advanced stage for a hazardous waste incineration project. A piece of land has been selected in Ping Nan Industrial Park in Pingtung County.

The French side expressed appreciation for the assistance provided to Tredi by the IDB. One obstacle to the operation remains however. Tredi's Application for treatment of PCBs over 50ppm was raised in the EPA hearing of Establishment License Application 12 months ago, in June 1999. A compromise was made to grant them a license for PCBs under 50ppm, with application for an amendment afterwards.

After the granting of its operation license in March 2000, the French company followed up on the issue of license amendment and is still waiting for the result.

The IDB adds the following information:

The reason why Tredi did not receive the license amendment earlier is that Tredi was supposed to file an application for a regular industrial waste treatment permit for clearing PCBs under 50 ppm but Tredi applied for a hazardous waste treatment license instead. The operation license Tredi granted is to deal PCBs that under 50 ppm. And according to the waste treatment regulations, PCB under 50 ppm is classified as regular rather than hazardous waste. The Taipei City Government has returned the application to Tredi and asked the company to reapply the license for regular industrial waste clearing instead.

附件二：

第十四屆中法經濟合作會議議程

MEDEF
INTERNATIONAL

FRANCE - TAIWAN

14th CHINESE-FRENCH ECONOMIC COOPERATION CONFERENCE

Tuesday, 17 October 2000 – MEDEF

PROGRAMM

14h30-15h00 Registrations

15h00-16h30 Plenary Session (Room Chaillot)

15h00 15h10 Welcome speeches by :

- Mr François PERIGOT, Chairman of MEDEF International
- Mr Richard Ching-Tang HSU, Chairman of the Chinese delegation and Vice-Chairman of Taiwan Power Company

15h10 15h30 Development of Industries in Taiwan / Investment opportunities in France

✓ 15h10-15h20 Mr Yen-Hsiang SHIH, Director General of Industrial Development Bureau, Ministry of Economics Affairs

✓ 15h20-15h30 Mr Jacques MALEVAL, Project Manager, International Investments delegation, Ministry of Economy, Finance and Industry

15h30 16h10 Presentation of France – Taiwan Cooperation Opportunities

✓ 15h30-15h40 Dr Elian LIAW, Managing Director of Biotechnology & Pharmaceutical Investment Program Office, Ministry of Economic Affairs

✓ 15h40-15h50 Mr Edward K.M. CHEN, Director of Fuel Department of Taiwan Power Company

✓ 15h50-16h00 Mr Charles V. WU, Counsellor of Tsar & Tsai Law Firm. Guidelines for foreign bidders participating in ROC Governments Procurement Project

✓ 16h00-16h10 Mr Blaise DURAND-REVILLE, Director of International Affairs and Development, CARREFOUR

16h10-16h40 **Debates**

16h40-16h45 **Conclusions**

15h45-16h30 ***Meeting for Biotechnologies and Chemical Industries delegates with Mr Louis TEULIERES, Director International Affairs and Operations, French Pharmaceutical Manufacturers Association, SNIP (Room MARCEAU)***

16h45-17h15 *Coffee Break (Antechamber Chaillot)*

17h15-18h15 ***Round tables / Individual meeting***

- **Energy Group** (Room CHAILLOT), co-chaired by :

  Mr Richard Ching-Tang HSU, Vice-President of Taiwan Power Company

  Mr René de PRENEUF, Vice-President International Development Asia, FRAMATOME

- **Transportations Group** (Room MARCEAU), co-chaired by :

  Mr Ru-Chu CHU, Director of Committee for Aviation and Space Industry Development (CASID), Ministry of Economic Affairs

  Mr Christian DUMAS, Vice-President, International Development, Political Affairs France, EADS

18h15-19h00 ***Cocktail (Antechamber Chaillot)***

19h00 ***Departure from MEDEF for the Dinner at Evergreen Hotel, hosted by IDB and Taiwan Power Company***

附件三：

第十五屆中比企業合作會議議程

FABRIMETAL

XVth Belgian-Chinese (Taipei) Economic Cooperation Conference

October 23, 2000

Fabrimetal

Diamant Building, Brussels, room Archimedes

Programme

October 23

10.30	Registration of the Taiwanese and Belgian participants
11.00	Opening remarks by Mr.de Buck van Overstraeten and Mr C.Y Wang, Chairman and co-Chairman of the Conference.
11.20	"Euro : its use & implications of by fluctuations for businessmen" by Mrs Carine Brasseur, Strategy Financial Markets, Fortis Bank
11.40	"Main guidelines for government procurement" by Mr C.V.Wu of Tsar & Tsai
12.00-12.20	Questions & answers
12.20-12.30	Signature of joint statement
12.30-14.15	Working lunch
14.15-16.30	One-to-one meetings
19.30	Dinner offered by Euro-Asia Trade Organization au Restaurant « Palais d'Asie » (rue Henri Maus 5, 1000 Brussels).

October 24

Separate visiting programmes for transport, bio-technological and environmental groups.

Taiwanese Officials

Table N°

1 Mr Yen-Chao Huang, Representative, Taipei Representative Office

1 Mr Yang Hong-Chi, Director, Taipei Economic Division

5 Mrs Shiu Li-mei, Commercial Secretary, Taipei Economic Division

Taiwanese Delegation

Table N°

1 Mr Chung-Yu WANG, Chairman, China Steel Corporation

1 Mr Fred P. C. HUANG, Chairman, Chung-Hwa Railway Industry Development Association (CRIDA)

2 Mr Hung-Chih WANG, Project, Co-director, Rolling-Stock Industrial Cooperation Committee Operation Office, Industrial Development Bureau, MOEA

2 Mr Chang-Jen HUANG, Manager, Chung-Hwa Railway Industry Development Association (CRIDA)

2 Mr Yung-Tsun WU, Project Manager, CTCI Corporation

4 Mr Wen-Tin HOU, President, Golden Grand Manpower Consultant Corp.

2 Mr Sheng-Hsiung YU, Plant Manager, Formosa Heavy Industries Corp.

4 Mr Ru-Chu CHU, Director, Committee for Aviation and Space Industry Development (CASID), MOEA

Table N°	
4	Mr Chang-Ming HSIAO, Administrator, Center for Aviation and Space Technology, Industrial Technology Research Institute (ITRI)
3	Mr Wen-Lan SHEN, President, Taiwan Electrical and Mechanical Engineering Services, Inc.
3	Mr Maw-Shiah SU, President, RPTI International Ltd.
3	Mr Li-Ching SUN, President, Taiwan Electric Research & Testing Center
3	Mr Fang-Cheng CHAO, Senior Vice President, Sinotech Engineering Consultants, Ltd.
1	Mr Teh-Huei CHOW, Chairman, Taiwan Cogeneration Corporation Star Energy Power Corporation
3	Mr Tsahn-Rarn CHENG, Planning & Business Department Manager, Taiwan Cogeneration Corporation
3	Mr Shiao-Yi LU, Deputy Director, R&D and Corporate Planning Division, Chinese Petroleum Corp.
5	Mr Chi-Chun LIN
5	Mr George KO, Chairman, Sintong Chemical Industrial Co. Ltd
5	Mr Jin WANG, President, Curie Pharmaceutical Co. Ltd
5	Mrs Mei-Huei CHEN, General Manager, Curie Pharmaceutical Co. Ltd
4	Mr Charles V. WU, Counsellor, Tsar & Tsai Law Firm
5	Mr Ting-Jeng LIU, Manager, Engineering. Department, Taiwan Water Supply Corporation (TWSC)
1	Mrs Melody P. HO, Director of Operation, Euro-Asia Trade Organization
5	Mrs Eunice P. WANG, Senior Specialist, Euro-Asia Trade Organization

Belgian officials

Table N°

1 Mr P. Van Haute, Director Asian Department
Ministry of Foreign Affairs
rue des Petits Carmes 23
1000 Brussels
tel. 02/501 81 11
fax 02/514 30 67

5 Mr D. Delattre, Conseiller adjoint
OBCE - BDBH
boulevard Roi Albert II 30
1000 Brussels
tel. 02/206 38 45
fax 02/203 18 12
mail : Ddelattre@obcebdbh.be

4 Mr D. Vandervelde, Attaché
Ministry Brussels Region, Foreign Trade
Louizalaan 500 bus 4
1050 Brussels
tel. 02/645 25 66
fax 02/645 25 70
mail : dvandevelde@mbhg.irisnet.be

附件四：

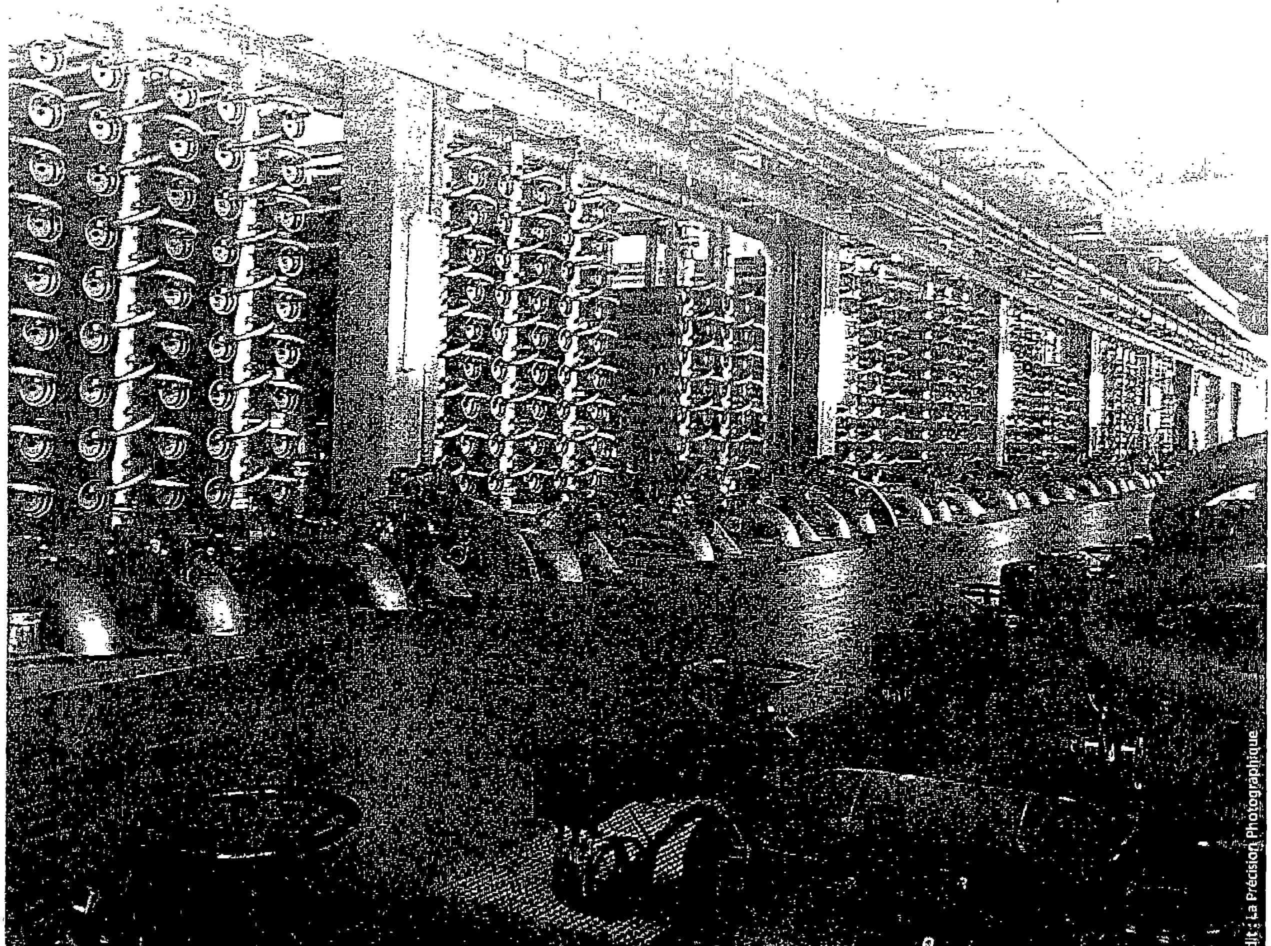
Mery 淨水場簡介資料

SYNDICAT DES EAUX D'ILE DE FRANCE

GÉNÉRALE des eaux

MERY 340,000

A SHOWCASE FOR NANOFILTRATION TECHNOLOGY



MERY 340,000
A SHOWCASE FOR NANOFILTRATION TECHNOLOGY

SEDIF is the water authority for the Ile-de-France which covers the area surrounding Paris. For many years, the authority has been carrying out an energetic policy to improve the safety of supply and the quality of the water. GENERALE DES EAUX is the contractor of SEDIF for the design of all its installations and for the operation of the plants and distribution of water.

INCREASING THE SAFETY OF THE WATER SUPPLY

The safety of the water supply for SEDIF's 144 municipalities is safeguarded by the mutual assistance systems built up between the three treatment plants located on the Marne, Seine and Oise rivers. To create such a system, SEDIF has had to make sure that production capacity is well balanced between the three plants, and that each plant has a sufficiently large capacity. The system also requires large diameter pipe links between the various plants.

SEDIF first turned its attention to the two main plants of Choisy-le-Roi and Neuilly-sur-Marne. Each plant treats 105 MGD of water, but that capacity can be doubled if required. The Marne-Seine pipe link was installed between 1986 and 1990, ensuring that each plant could help the other.

The SEDIF's elected officials decided to extend this policy by bringing the Méry-sur-Oise plant into the system :

- ✓ through the creation of the Oise-Marne pipe link and
- ✓ by increasing the plant's treatment capacity from 35 MGD to 90 MGD.

There were other reasons behind their decision :

- ✓ municipalities in the northern district sector served by the Méry-sur-Oise plant have been undergoing steady growth, increasing their water requirements ;
- ✓ water distributors abstract less water from the Oise river than from the other two rivers, and the Oise river has sufficient water even at low levels.

Increasing the Méry-sur-Oise plant's treatment capacity should meet the growing needs of the northern district, and provide back up to the eastern district through the new Marne-Oise pipe link.

Another priority can be added to the fundamental requirements of quantity and safety : water quality.

IMPROVING QUALITY

In the 1980s, SEDIF significantly improved the treatment processes used in its plants by adding biological filtration on granular activated carbon. This was carried out in 1983 at Méry, 1985 at Choisy and 1992 at Neuilly.

For Méry, the SEDIF's elected officials decided to increase the capacity of the plant and at the same time install a new process. Water from the Oise contains more organic matter than the water from the other two rivers and is therefore more difficult to treat. In order to provide water quality equaling that of Choisy and Neuilly, the Méry extension will use nanofiltration, a membrane filtering process.

A prototype unit built within the Méry plant has been supplying the Auvers-sur-Oise municipality since 1993. The municipality was chosen because it is supplied by an independent network with no connections to other municipalities. For almost six years, the 6,000 people living in Auvers have been supplied with nanofiltered water which is softer than the water they previously received and has no chlorine taste.

A survey showed that consumers in Auvers were highly sensitive to the improved taste, clarity and, above all, softness of the water.

Convinced by the success of the experiment which was carried out under the supervision of the French Ministry of Health, SEDIF's elected representatives selected nanofiltration as the refining process for water in the new treatment line.

NANOFILTRATION AT MERY

The extension of the Méry-sur-Oise water treatment plant, which will go into service in October 1999, will be the first to use nanofiltration for the treatment of river water. The softened water produced will be of very high quality and the slight amount of chlorine added at the end of the process will be undetectable to the consumer.

■ What is nanofiltration on membranes ?

Nanofiltration is a relatively new membrane process that uses electrically charged membranes with pores. These pores are larger than Reverse Osmosis (RO) membranes, but too small to allow permeation of many organic compounds such as biodegradable organic carbon.

The advantage of nanofiltration compared to RO is that the energy required to perform the separation is drastically reduced.

Thus, nanofiltration membranes filter out organic matter and dissolved organic carbon, including its biodegradable matter that can support bacterial growth in the distribution system.

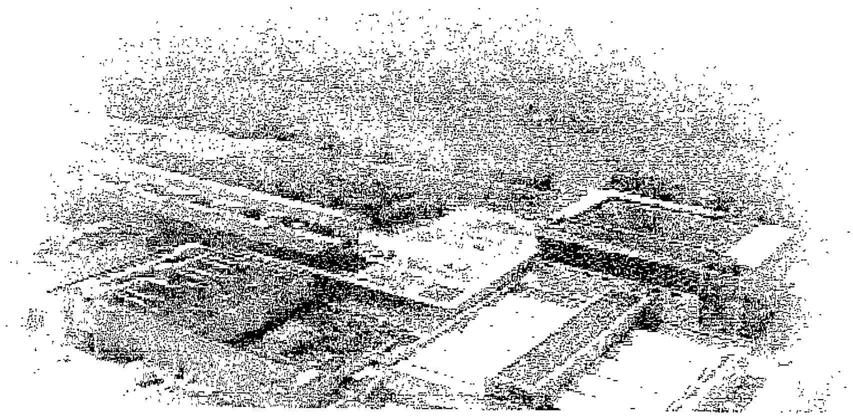
Membrane filtration has been in widespread use for 20 years in a number of situations :

- producing ultra-pure water in laboratories,
- desalinating sea water through reverse osmosis in land-based plants as well as in ships and on oil platforms,
- boreholes for drinking water,
- in the food industry, either for filtering water used in manufacturing products such as fizzy drinks or to eliminate excess water and make concentrates.

In all these applications, the water to be treated always has invariable physical characteristics. Applying the process to river water, the only resource available to SEDIF, is a completely different matter. The physical characteristics of river water are highly variable. The temperature for instance can range from 1 to 25°C (34 to 77°F) depending on the season, and levels of suspended solids and pollutants differ greatly. This is why the Méry-sur-Oise project to use nanofiltration for river water on a large scale is a world first.

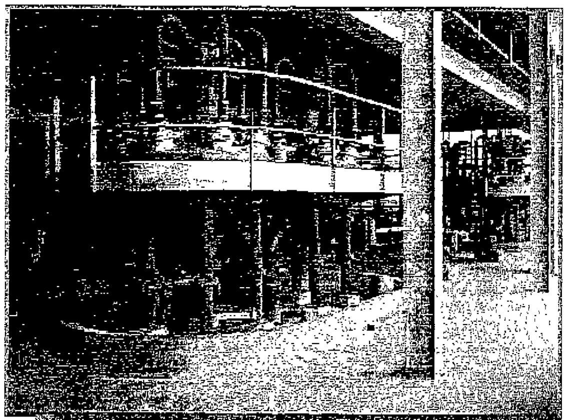
THE EXPANSION OF THE MERY-SUR-OISE PLANT

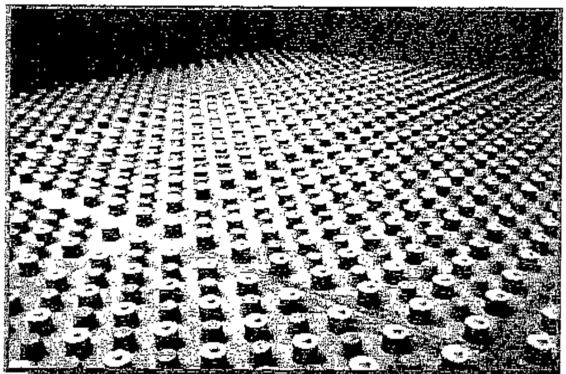
The nanofiltration membranes at the Méry-sur-Oise plant will give 800,000 people living in the northern part of the Paris region the benefit of softer water with no chlorine taste. The new plant will have two independent treatment lines working in parallel: the current line, using the biological process, and the new line using nanofiltration in the plant extension. The two lines will be supplied at the same time by feeder pumps that have been adapted to ensure an adequate flow rate. New pipe line links have been installed to transport the water from the feeder pumps to the new plant.



THE NEW TREATMENT LINE
(see appendix 1)

Pretreatment


Hydrocyclones


Filter bottom

The water pumped from the Oise is left to settle naturally for around two days in the raw water storage reservoir. It is then fed into the pretreatment units of the two treatment trains.
The new line's pretreatment unit can handle 47 MGD and includes:

- ✓ coagulation-flocculation,
- ✓ lamellar settling with two Actiflo (weighted floc settlers),
- ✓ ozonation, with ozone produced from oxygen,
- ✓ dual-layer filtration through sand and anthracite in ten concrete filters. The filters' retention of particles is optimized by injecting a coagulant upstream from the filtration process (bonding).

At the end of pretreatment, the clarified water is stored in a reservoir before continuing on to the nanofiltration plant.

Nanofiltration

Before being pressurized through the nanofiltration membranes, the water is pumped through prefilters that protect the membranes by eliminating any remaining large particles. They act as "safety fuses" in case the water still contains too many suspended solids due to a malfunction in the pretreatment process. The water that has passed through the prefilters is then pressurized to 8 to 12 bars (116 to 174 psi) depending on the water temperature.

The nanofiltration plant comprises eight independent lines. Each line has three arrays. The size of each array is designed to ensure filtration of half the inlet flow. On leaving the third array, 15% of the initial flow will be discharged into drains, resulting in an overall feed water recovery of 85%. Each line is able to produce 4,6 MGD, totaling 37 MGD for the plant as a whole.

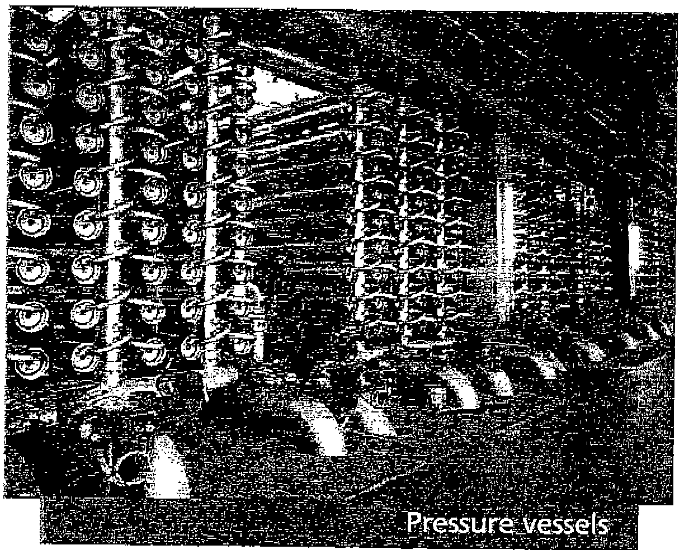
The three arrays of each line comprise 108, 54 and 28 pressure vessels respectively for a total of 190 tubes per line and 1,520 pressure vessels for the plant.

Each pressure vessel holds six spiral wound modules, each module measuring 40" length. There are 1,140 membrane modules per line and 9,120 for the plant.

Each membrane module is composed of 29 double sheets rolled into a spiral, offering an effective filtering surface of around 400 Sq.Feet. Each line therefore has 10 acres of effective filtering surface, adding up to 84 acres for the plant, the equivalent of seventy football fields ! All the equipment is housed in a building of around 4 300 Sq.Yards.

Developed especially for the Méry-sur-Oise plant by Filmtec, a Dow Chemical subsidiary based in Minneapolis (USA), in cooperation with Anjou Recherche and OTV, the polymer membranes were tested on the prototype unit that has been supplying Auvers since 1993.

The carbon dioxide due to the acidification of the water to prevent scaling is then removed from the nanofiltered water by degassing. Lastly, as a final safety measure, the water is disinfected using UV Medium Pressure, a process that is highly effective on this very clear water. At the same time, the remaining acidity is neutralized by adding a slight amount of soda.


Pressure vessels

Post-treatment

The plant expansion has been designed to allow the two trains to work at full capacity whenever needed. The nanofiltration plant will operate at its normal capacity of 37 MGD. The original plant will normally operate at a capacity of over 8 MGD, which will allow to distribute water at full capacity when required (53 MGD).

The water is then mixed with nanofiltered water, in a proportion of 80% nanofiltered water for 20% from the other treatment train. The percentage of biologically treated water can be increased, depending on demand and distribution network management priorities. In effect, the biological treatment plant will provide top-up capacity in normal conditions and back-up capacity in an emergency.

Now disinfected and neutralized, the mixed water is transported to a reservoir before being pumped to the distribution network.

OTHER INNOVATIVE FEATURES

■ Coagulant static mixer :

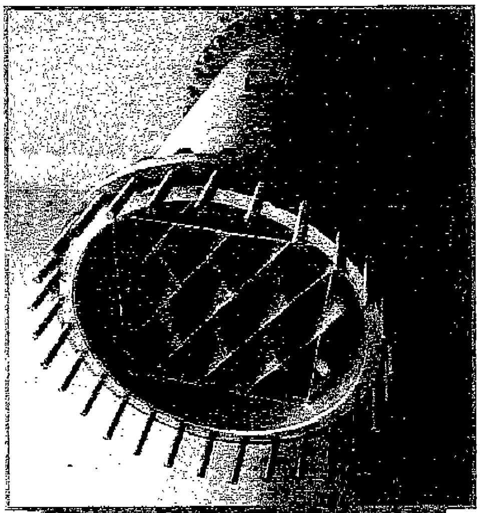
In order to reduce the size of civil engineering works, the first concrete tank for injection and flash dilution of coagulant has been replaced by a 100" long static mixer. The performance of this mixer allows the dilution of the coagulant in less than one second, with high energy efficiency.

■ Ozone static mixer :

A static mixer consists basically of a sequence of stationary guide plates which allow a systematic radial mixing of media flowing through the pipe. The flow path follows a geometrical pattern, excluding any random mixing.

An ozone/water mass transfer procedure with static mixers has great advantages in terms of investing and operating :

- ✓ small space requirement and reduced structures,
- ✓ in association with oxygen supply, no need of additional compressor and air dryer, reduced automation equipment,
- ✓ low pressure drop (2.1 psi) and energy consumption,
- ✓ highly homogeneous mixing,
- ✓ high ozone utilization factor (>90%),
- ✓ no mobile parts to be maintained,
- ✓ high MTBF,
- ✓ raw water treatment capability.



Static mixer

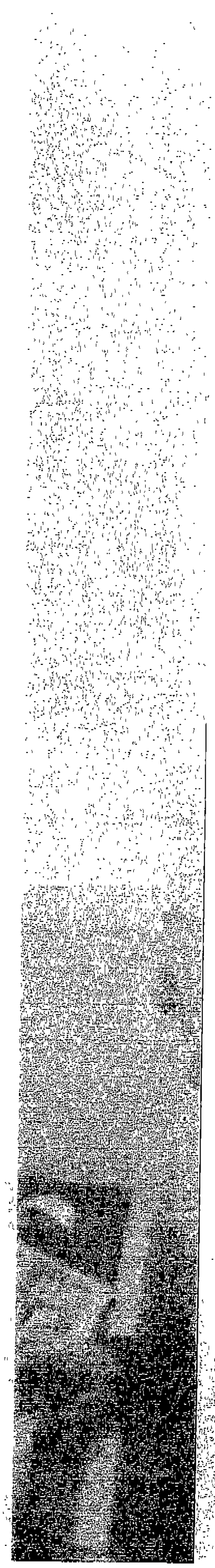
■ Automatic Control System "Level 3 system" :

In addition with a classical SCADA system (which requires operators 24 hours a day in the control room to manage the plant), the plant is also equipped with an "Automatic Control System", also named "Level 3" system according to the control architecture of the plant (level 1: PLCs, level 2: SCADA system, level 3 : automatic control system).

Based on a powerful Expert System software and linked with the SCADA system, "Level 3" system is able to manage the plant during nights and weekends without any operator in the plant.

Level 3 system manages strategic planning decisions, daily forecasts the water consumption and coordinates the different process steps in the plant ; Level 3 system supervises the automated operations managed by PLCs and detects deviations.

When problems occur, level 3 system analyzes the causes and decides on the action to be taken, for example to revise the production strategy, to page an operator on duty, or to slow down and stop the plant in case of dangerous situation.



■ Field bus technology in order to manage smart sensors and valves

Each of the eight nanofiltration lines is equipped with 32 smart sensors (pressure, flow, conductivity) and 55 valves (256 sensors and 440 valves for the nanofiltration unit). Instead of classical Input/Output links technology, a field bus solution has been implemented between :

- ✔ sensors and PLCs, (FIPWAY protocol of Schneider),
- ✔ sensors and a centralized management system (AMS system of Fisher Rosemount),
- ✔ valves and PLCs.

Field bus technology has many benefits :

- ✔ reduced costs of implementation and maintenance (no classical I/O links),
- ✔ high level of reliability,
- ✔ centralized management of smart sensors from a dedicated workstation (remote parameter setting, calibration, etc...),
- ✔ hardware and software architecture of PLCs is simplified (no management of smart sensors, less I/O links with the process, etc...).

■ Membrane cleaning in place "à la carte"

Each membrane unit is equipped with pressure, flow and conductivity sensors. Thus, calculators are able to know at any given time if a membrane unit is clean or fouled. If a membrane unit needs to be cleaned, notice is given to the operator who triggers the cleaning procedure or decides to change the recipe. The operator has various recipes at his disposal but he also may decide to apply a recipe of his own (for instance he may choose to increase the concentration of a cleaning solution or the soaking time). This new recipe is then stored in the computer for further usage. When the cleaning is over, a report is edited which gives, among others, the efficiency and the cost of the cleaning.

■ Automatic pH adjustment of the finished water

A pH adjustment is necessary to achieve a positive value of the calcium carbonate saturation index of the finished water (corrosion control). At the end of the treatment line, the permeate of the nanofiltration (aggressive) is mixed in various proportions with the water coming from the conventional plant (over saturated). The calcium carbonate saturation index of the mixed water is then highly variable with time. The quantity of sodium hydroxide to be added is calculated from the characteristics of the permeate on one hand and the conventional plant outlet water on the other hand, the variations of both flow streams are taken into account as soon as they occur.

■ On line measurement of the fouling index

Prior to nanofiltration, the feed water is monitored on line with an automatic Fouling Index apparatus that performs a measurement every half an hour. The apparatus reproduces the manual measurement of the SDI (ASTM method).

COST OF THE NEW TREATMENT LINE

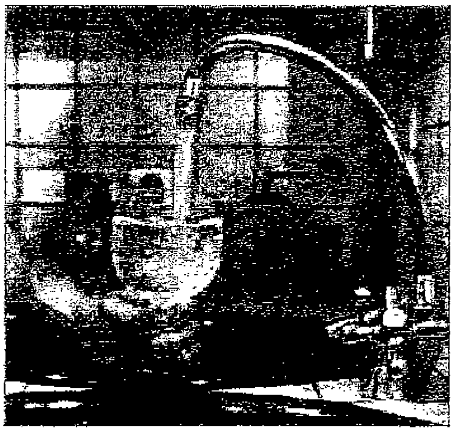
The cost of the entire operation, including the plants described above and the various adaptations to the biological treatment train, is around US $ 135 millions at 1994 value, excluding the 20.6% Value Added Tax.

Vivendi Water units involved in the project:
- ✓ design, project management and commissioning - Suburbs of Paris engineering department,
- ✓ several works contracts have been awarded to Campenon Bernard, Sade, GTIE, OTV.

IMPACT ON THE PRICE OF WATER

The construction of the Méry expansion accounts for 20% of the capital investment budget for SEDIF's current five-year plan. For practical, technical and financial reasons, and in order to keep low borrowing, the expenditure has been spread over five years. Operating costs have been minimized through the use of optimized, standardized equipment.

However, the additional cost of treating water by nanofiltration is estimated at around 12 cents (excluding VAT) per cubic meter (45 cents per one thousand gallons). This extra cost will be compensated for by savings in other areas. The Méry-sur-Oise plant extension will therefore not lead to a price increase in water for consumers.



INTEGRATING THE NEW FACILITY INTO THE SITE AND LIMITING ITS EFFECT ON THE SURROUNDING AREA

The Méry plant expansion project included site surveys to optimize the integration of the new buildings into the environment.

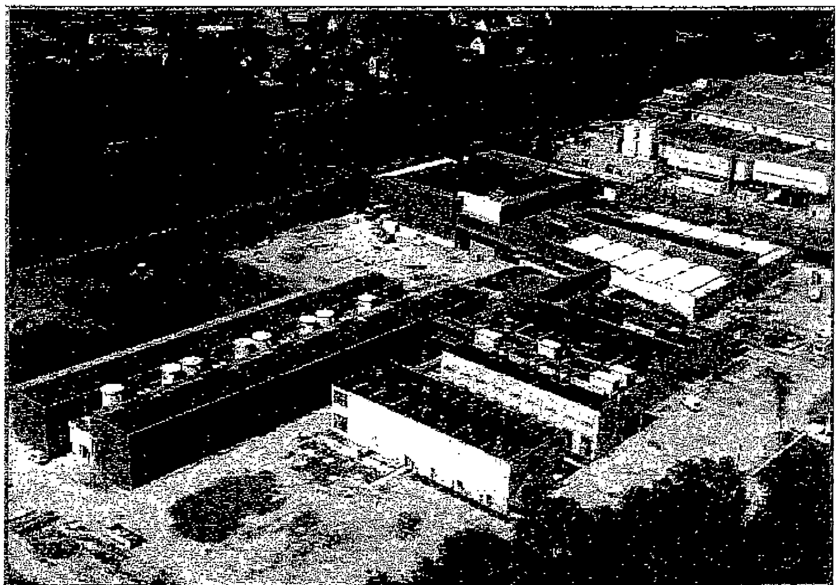
The plant expansion was decided in agreement with France's Ministry of Health, the local health and social services authority and the local sanitation committee.

In addition, integration into the site was facilitated by choosing nanofiltration as the refining process since this has led to the design of a very compact plant – half the size of the existing plant for similar production capacity.

INTEGRATING THE PLANT INTO THE SITE

- ✓ A major effort has been made to integrate all buildings into the surrounding area. The nanofiltration building, for example, is glass-fronted with copper panels.
- ✓ From the banks of the River Oise, the facility will be surrounded by a vast area of trees and plants so that it blends into the landscape.

Three hundred tall trees will also be planted around the facility, representing one tree for every 170 m² (200 Sq-Yd). Several varieties have been chosen.



Bird's-eye view of the new plant

A MODEL WORKSITE

We have taken the necessary measures to keep disturbances to a minimum during plant construction.

- A temporary access road has been built to guarantee the safety of pedestrians and car drivers. It allows vehicles to move into and out of the worksite without causing traffic jams on the main road. This has improved traffic flow and made it safer.
- Work at the site has been concentrated into a strictly controlled timetable from 8am to 5pm, Monday to Friday.
- Trucks carrying earth are cleaned regularly, and the tyres washed after every unloading operation. A roadsweeping machine is used immediately in the event of spillage onto the road.
- The worksite perimeter is fenced in and under non-stop surveillance.

COMMUNICATING WITH AND INFORMING RESIDENTS

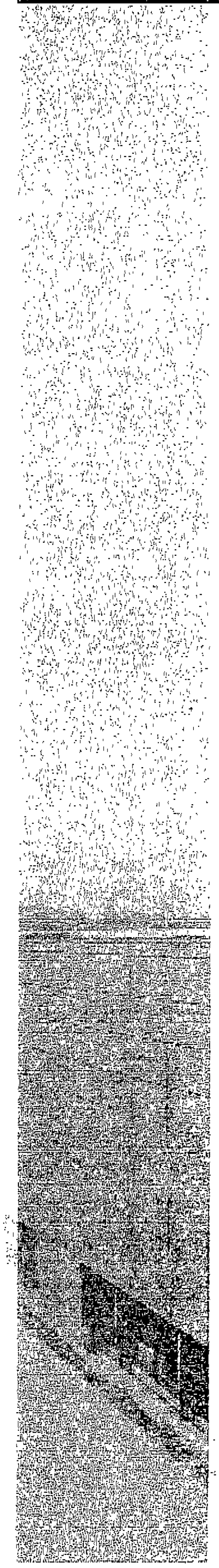
- An information campaign for Auvers residents was launched in 1993 before they started receiving nanofiltered water. Four target groups were selected : medical and paramedical professionals, children, associations and the general public. In addition, two films were made: "Auvers-sur-Oise, millésime 93" gave a simple explanation of the technical aspects of nanofiltration ; "Méry 340,000" explained the plant expansion project.
- A toll-free phone number was available during the whole construction phase so that Méry and Auvers residents could raise any questions they had about subjects such as the duration of the worksite and possible disturbances.
- A detailed leaflet describing the overall project and its schedule was distributed to all Auvers and Méry residents.
- SEDIF has installed a water fountain near the storage reservoir opposite the plant entrance so that Méry residents can sample nanofiltered water. The fountain is in the form of a block of granite to symbolize the purity of water delivered by mountain springs.
- A display board bearing the message "In 1999, our new plant will produce softer water with no chlorine taste" was set up at the site entrance.

Video footage of the worksite has been taken regularly since 1995, and two films tracing its various phases have already been presented to SEDIF's elected officials and the different project partners.

For further information please feel free to contact
Guy Bablon
(head of the water engineering department) :

phone : + 33 1 55 23 42 21
fax : + 33 1 55 23 47 19
e-mail : guy.bablon@generale-des-eaux.net

KEY FIGURES FOR THE WORKSITE



BUILDINGS AND BURIED NETWORKS

The worksite represents :

- ✓ 12 new buildings with a surface area of 3.5 acres, including three hydraulic structures with a total capacity of 28,000 m3, erected entirely on piles and moulded walls;
- ✓ 6 new pipes with diameters of between 3 – 7 ft. covering a distance of 1,300 yards, supported entirely on piles;
- ✓ a sewerage network measuring 1,200 yards;
- ✓ a network of utilities conduits with a total length of 550 yards;
- ✓ civil engineering.

	Pretreatment	Refining	Post-treatment	Total
Concrete	10,000 m^3	18,500 m^3	6,600 m^3	35,100 m^3
Steel	1,100 metric ton	1,100 metric ton	1,100 metric ton	2,820 metric ton
Form-work	30,000 m^2	23,000 m^2	23,000 m^2	71,000 m^3
Piles	300	320	320	850

The plant expansion will have generated between 100 and 300 jobs on site for three years. In addition to these and the 50 employees working for the project management, many jobs have been created at subcontracting companies for parts fabricated outside.

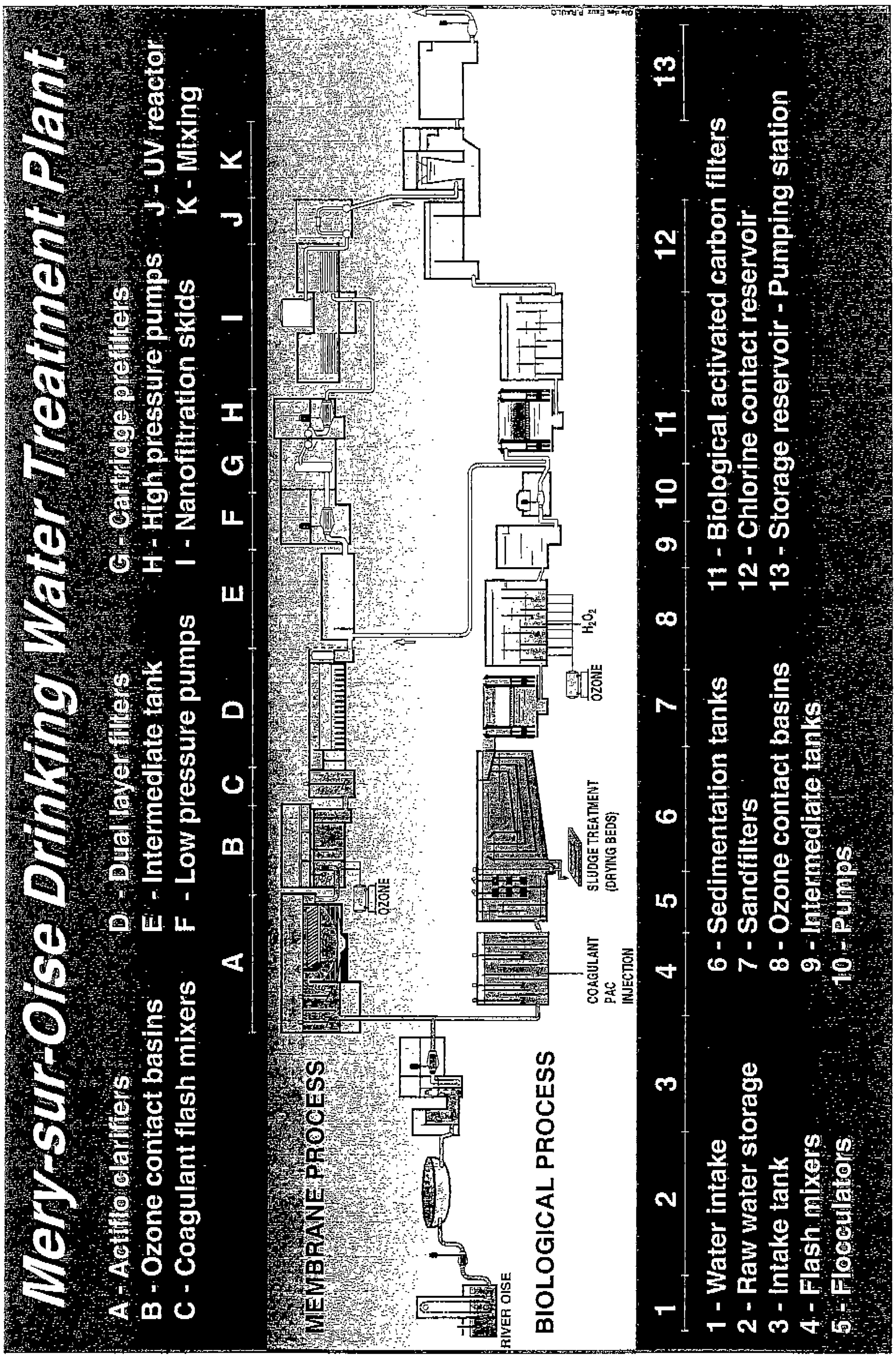
INTERIOR WORKS ; ELECTRICAL, HYDRAULIC AND VENTILATION EQUIPMENT ; AUTOMATION

The worksite represents :

- 4,300 Sq.Yards of glass walls (half a football field);
- 9,200 Sq.Yards of tiled surfaces (a whole football field);
- 2,100 Sq.Yards of copper panels;
- 1,800 Sq.Yards of corrosion resistant polyester platforms;
- electrical equipment : 14 electric transformers, with 15 MW (20,115 hp) installed capacity;
- 31 air conditioning and ventilation units with a total capacity of 26,400 gallons per hour;
- hydraulic equipment : 1,700 valves and sluice gates and 6.2 miles of internal pipework, of which 4.6 miles in stainless steel.

Low pressure pumps

Appendix 1



Mery-sur-Oise Drinking Water Treatment Plant
A - Actiflo clarifiers
B - Ozone contact basins
C - Coagulant flash mixers
D - Dual layer filters
E - Intermediate tank
F - Low pressure pumps
G - Cartridge prefilters
H - High pressure pumps
I - Nanofiltration skids
J - UV reactor
K - Mixing
A B C D E F G H I J K
MEMBRANE PROCESS
BIOLOGICAL PROCESS
RIVER OISE
OZONE
COAGULANT PAC INJECTION
SLUDGE TREATMENT (DRYING BEDS)
OZONE
H_2O_2
1 2 3 4 5 6 7 8 9 10 11 12 13
1 - Water intake
2 - Raw water storage
3 - Intake tank
4 - Flash mixers
5 - Flocculators
6 - Sedimentation tanks
7 - Sandfilters
8 - Ozone contact basins
9 - Intermediate tanks
10 - Pumps
11 - Biological activated carbon filters
12 - Chlorine contact reservoir
13 - Storage reservoir - Pumping station

Michel Mercier,
Directeur Général
des Services Techniques

Gérard Chagneau,
Ingénieur en Chef,
Chargé d'opération

Bernard Cyna,
Directeur de secteur,
Directeur Exploitation

Guy Bablon,
Directeur de projet,
Direction des Études
et de l'Ingénierie

SYNDICAT DES EAUX D'ILE-DE-FRANCE
14, rue Saint Benoît
75006 PARIS
Tél. : 01 53 45 42 42
Fax : 01 53 45 42 69
E-mail : sedif@sedif.com
www.sedif.com (à partir du 17 novembre)

VIVENDI - GÉNÉRALE DES EAUX
exploitation de la Banlieue de Paris
32, place Ronde - quartier Valmy
92982 Paris La Défense Cedex
Tél. : 01 55 23 30 00
Fax : 01 55 23 47 19
E-mail :
guy.bablon@generale-des-eaux.net

附件五：

CIBE 水公司簡介資料

Compagnie Intercommunale Bruxelloise des Eaux

rue aux Laines 70 – 1000 Bruxelles - Telephone : 02/518 81 11 - Telefax : 02/518 83 06

ISO 9002 - Water production : our job

Turnover : 5.6 billion BEF (1996)
Staff : 1,424
Population supplied : 2,100,000

Annual supply : 138.1 million m³
(of which 59 % is groundwater and 41% surface water)

CIBE : An all-round water specialist

The «Compagnie Intercommunale Bruxelloise des Eaux» established in 1891, is one of the most important water supply companies in Belgium.

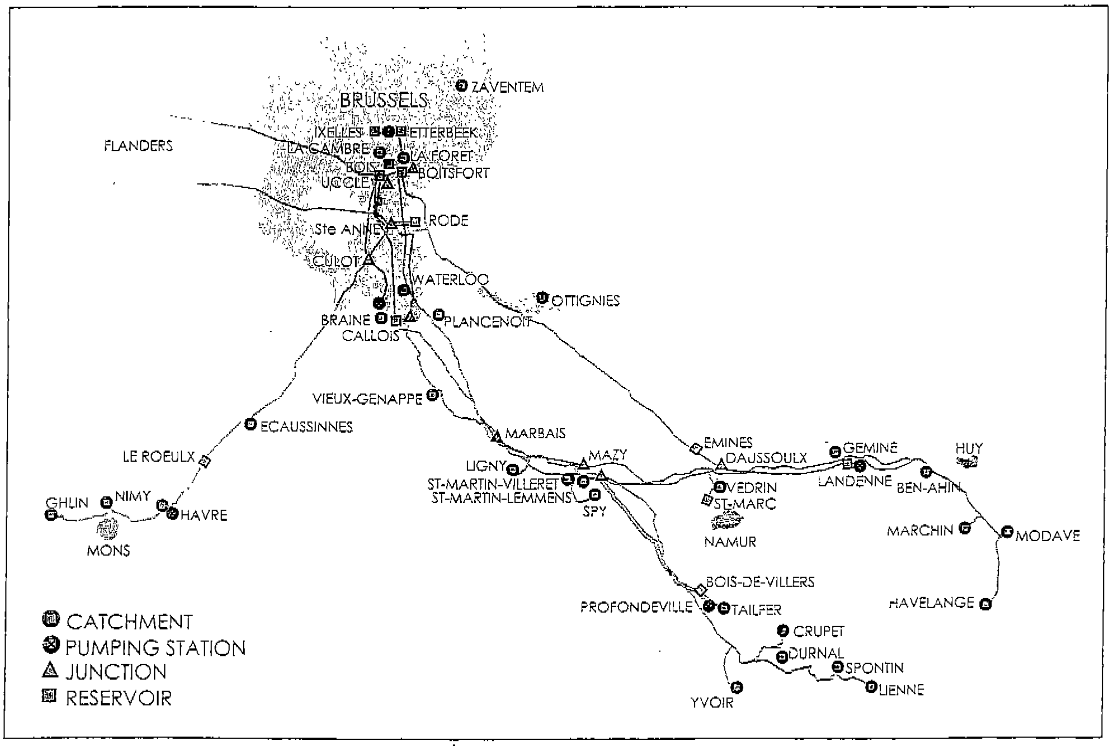
Day after day it supplies about 400,000 tons of water to 2.1 million inhabitants in the 3 regions of the country.

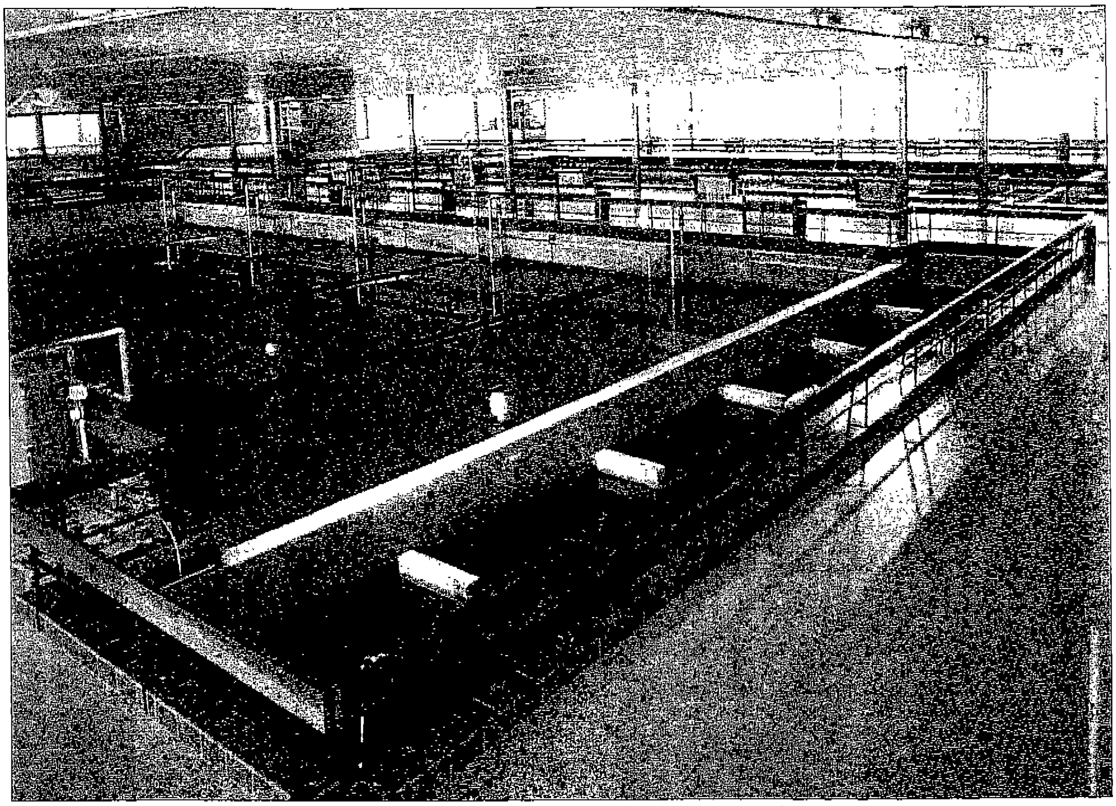
As a public service and an industrial enterprise, CIBE has two main tasks : it produces pure water that it supplies essentially at the entrance of its 38 member cities and municipalities; it also supplies services to associations of municipalities and individual municipalities that entrusted it with the operating of their water supply network and the service to the consumers.

Finally it was entrusted with the exploitation of the south station for waste water treatment in the Brussels Capital Region.

All CIBE's activities are specifically directed towards water. It studies, constructs, operates and develops plants for catchment, filtration, treatment, pumping, stocking and supply of water.

CIBE's total production, transport and storage facilities





Tailfer. Flocculation - decantion basins.

Security from diversity

The continual research for adequate means of production to meet the regular growth in demand has led CIBE to gradually extend its catchment installations and to administer this whole system which is carefully dispersed, both geographically and geologically.

Apart from the constraints, which it imposes on the working of the catchment and distribution system; this dispersion offers considerable advantages with regard to the quality of the product and the reliability of the supply. Spreading the catchment system across 27 major sites in 5 provinces and 6 aquifers unquestionably constitutes a factor of security.

Purification of all kinds of water

CIBE is one of the rare Belgian water supply companies to be confronted with water of such a different origin and composition. Engineers, chemists and technicians constantly improve the multiple treatments. These treatments include : the fight against sea-weed proliferation and eutrophization (in the quarries of Ecaussinnes), the massive deferrization of water from a former iron mine in Vedrin, the successive filtrations of the Meuse water in Tailfer. This model industrial complex with an elaborate technology harmonizes primary physical treatments with a minimal dosage of disinfectants and reagents; there is a last sterilization with ozonized air generated by the plant itself.

Continuous transportation

In order to convey a yearly quantity of about 140 million m3, CIBE became an important contractor of public works. It put 500 km of conveying mains through woods, rocks, valleys, villages, under bridges, two rivers, and 221 km of distribution pipes.

It built and maintains supply networks with a length of 4,135 km.

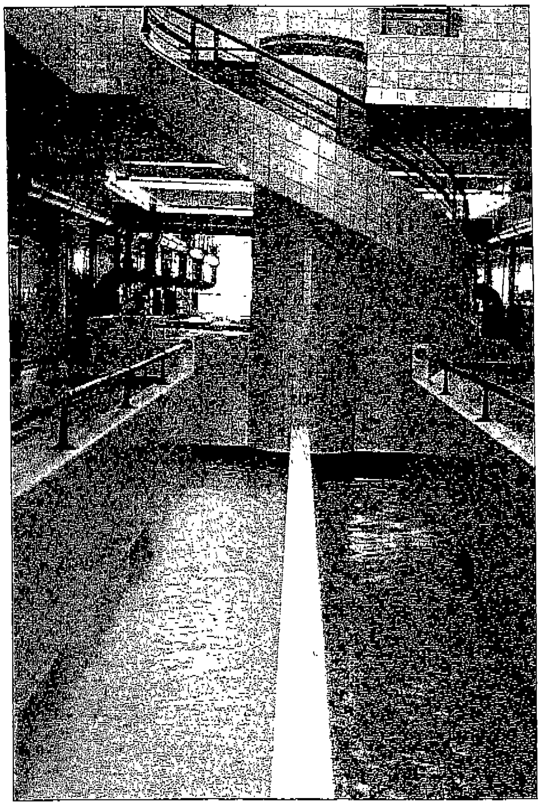
These supply facilities have been built for several decades and are in steel, sidero-cement, cast iron or PVC, according to the kind of water or soil and also to the necessary pressure and the volume to be transported.

With 4 pumping plants, 2 equilibrium towers, 7 reservoirs upstream and 6 downstream the conveying pipes guarantee that the consumers get the water at the right pressure.

Protect the water and its environment

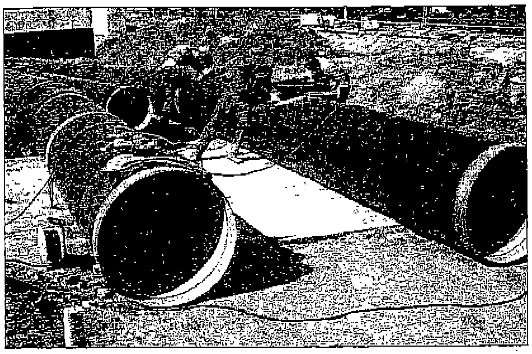
Since its foundation, and even before the word «ecology» existed, CIBE protected the purity of its groundwater by purchasing the ground where the water is impounded and in which the conveying pipes are laid.

In time it extended these zones to the maximum in the 5 provinces. Nowadays it constantly supervises 1,185 ha around its catchments and more than 346 ha with conveying pipes.



Vedrin. The filtration room.

Modave. The catchment gallery.



Laying of large diameter pipes.

Its concern about water also preserved vast natural zones where fauna and flora are protected.

Owning these zones, CIBE can protect them against any pollution. It regularly controls these spots and their surroundings, holds public inquiries and analyses water samples taken every day in different places.

A constantly controlled quality

CIBE's water is of an irreproachable quality : it is controlled in the catchment, in the plants, by several measuring or alarm devices, in the laboratories of CIBE.

Samples are taken every day in the catchments, treatment plants, reservoirs, measurement facilities and pipes. These samples are examined by chemists and enable to control all production and supply stages. The tests vary from very simple ones to very complicated ones.

CIBE ensures that 61 quality parameters and criteria are complied with.

These parameters are enacted by the regions, the national authorities, the EEC and the World Health Organization. CIBE also sees to stay well under the authorized maxima for harmful products (nitrates, pesticides, etc.).

100 years of guaranteed supply

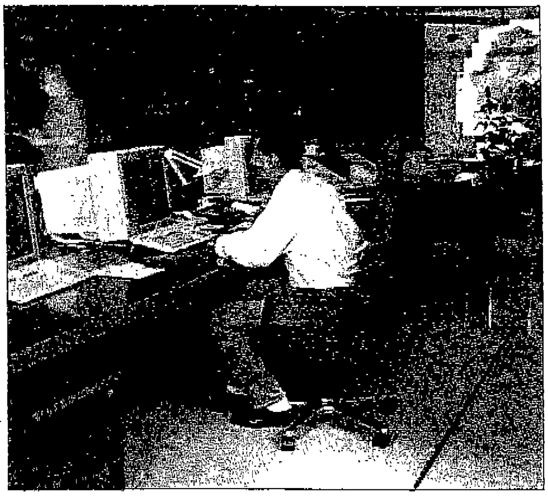
Consumers supplied by the «Compagnie Intercommunale Bruxelloise des Eaux» don't need to fear any scarcity. Supply is guaranteed by the different catchments spread over 28 spots in 4 provinces. Due to the interaction between certain feeders and reservoirs and the important storage, all consumers always got pure water at the right pressure in abundance even when in other parts of Belgium or Europe water was in short supply.

CIBE certainly holds a record : for a century it never had to call for restrictions.

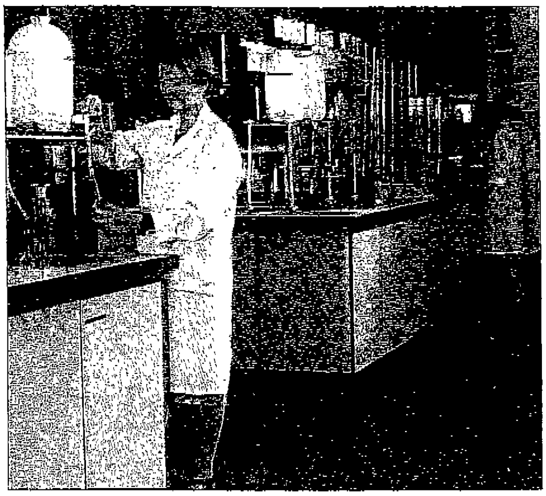
Supply specialized services

CIBE takes care of all activities connected with a water supply service in the networks of IBDE («Intercommunale Bruxelloise de Distribution d'Eau») composed of the 19 municipalities forming the Brussels Capital Region and of IWVB («Intercommunale voor Waterbedeling in Vlaams Brabant» to which are affiliated 12 Flemish municipalities that are also member of CIBE) and IECBW (Intercommunale des eaux du Centre du Brabant Wallon to which are affiliated 4 of CIBE's member municipalities). It also takes care of these activities in the networks it manages for other member municipalities.

In this respect, it carries out every work for operating, spreading, maintaining and repairing all supply facilities between the entrance of CIBE's network and the entrance of private houses or collective buildings.



Brussels. The central control room.



Brussels. The Cambre laboratory.

CIBE sets up or replaces watermeters, sets up the cathodic protection of the mains and controls industrial or private equipment which could pollute the water.

It constantly checks the pressure at strategic spots and, in case of fire, immediately adjusts the pressure according to the needs of the firemen. As a general rule, the consumers and the public may 24 hours a day appeal to a guard service.

Diversity management

To have this imposing technical structure working well and adapted to changing needs, substantial investments and qualified services are necessary. To obtain the necessary financing, managers need to pursue strict commercial policies to balance the activities financially.

Service and water sales to the consumer are invoiced at tariffs decided by the administrative organs of the associations of municipalities or the municipalities themselves and accepted by the tariff department of the Ministry of Econonmic Affairs. Due to its importance, consumption is read on a yearly, quarterly or monthly basis resulting in about 500,000 invoices yearly. The commercial departments collect the invoices, taking care for the social impact of their action and respecting the statutory and legal regulations.

Total quality management

Confident of the long tradition of quality in its product and services, CIBE wanted to prove its efficiency to its associated members and customers. From 1993 it resolutely started a programme of «Total Quality Management» aiming at the official certification of its quality control system. It comprises all management aspects : the product, services, human resources, finances, security, supply, logistic, commercial management, communication, but also the environment, the care for the customers, anticipation of demand, technological advance, scientific research,... By its decision of 30th November 1995, the certification organization AIB-Vinçotte Inter certified that the organization, working and quality of CIBE's activities for catchment, treatment and transport of water supplies in the public network correspond to the criteria of the ISO 9002 standard.

The total quality management programme is continuing in order to obtain as soon as possible the certification for the provision of water supply services, CIBE's other important activity.

Through its policy of continuous improvement at all levels, CIBE intends to progress on the road of excellence and to monitor the efficiency of its management for the satisfaction of its customers.

COMPAGNIE INTERCOMMUNALE
BRUXELLOISE DES EAUX

Ed. 1997

Compagnie Intercommunale Bruxelloise des Eaux

rue aux Laines 70 – 1000 Bruxelles - Telephone : 02/518 81 11 - Telefax : 02/518 83 06

ISO 9002 - Water production : our job

Tailfer

A surface water catchment plant on an industrial basis

Function

To impound water from the river Meuse, treat it and deliver it in the public distribution networks.

Location

On the right bank of the river Meuse in the municipality of Profondeville, Lustin section, 9 km south of Namur.

Historical summary

1964 Since the drinking water needs of the cities and municipalities it supplies, were ever increasing, CIBE gradually saw its groundwater resources become insufficient. CIBE therefore had to have recourse to surface water. It asks permission to impound water from the river Meuse, upstream from Namur, before the polluted water of the Sambre flows into it.

1968 CIBE gets the final permission for using surface water. The work starts in spring 1969.

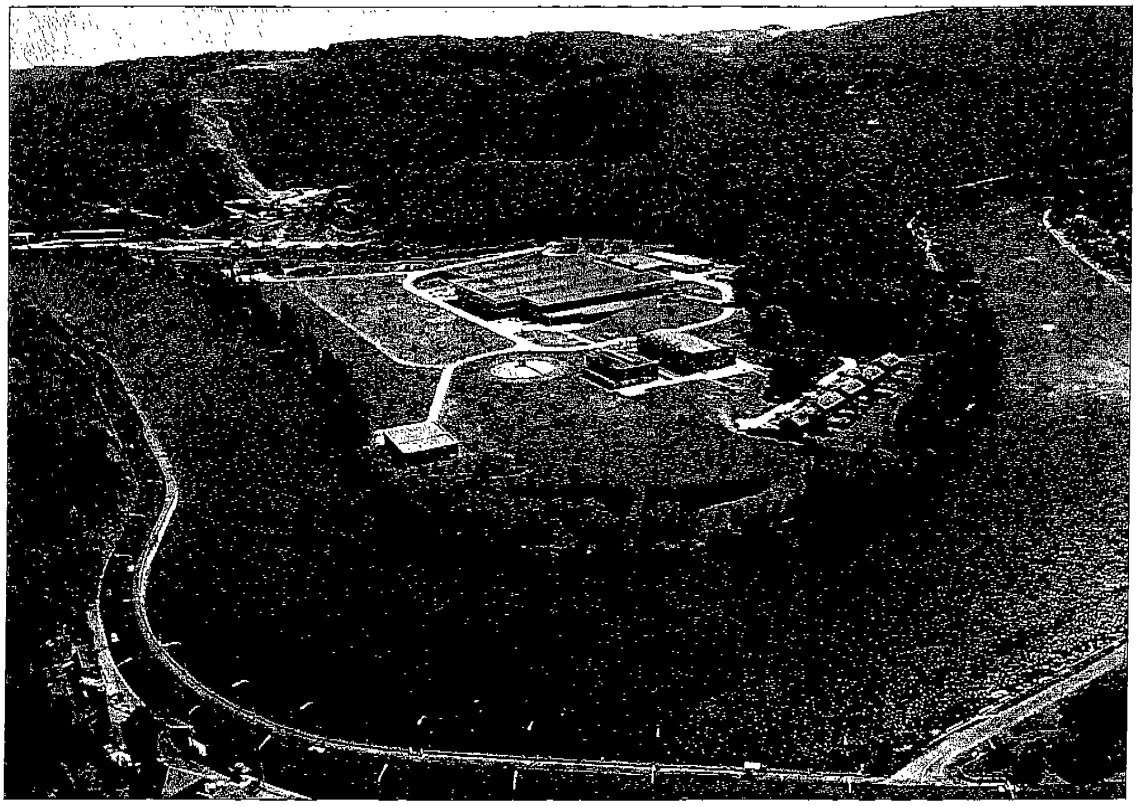
1973 On 4th June, the first one of the plants' four modules furnishes 65,000 m3/day; the second one, with the same flow, is in working order in September.

1974 The third and fourth module are finished in December.

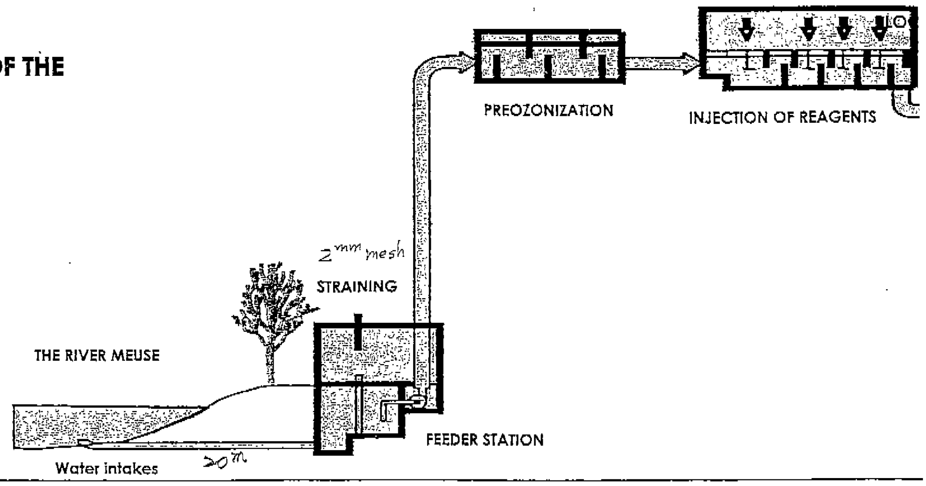
1976 End of the work.

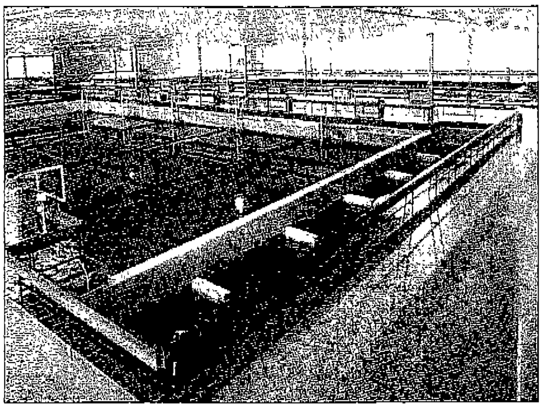
From 1976 till now the plant undergoes numerous modifications and adaptations : a pre-ozonization (1993) and advanced computer technology (programmable automatons) are installed.

Tailfer - Aerial view of the complex

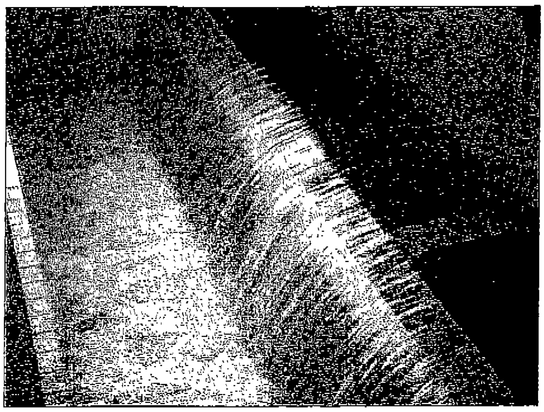


SCHEMATIC PROFILE OF THE WATER TREATMENT





Interior view of block B



Treated water

Summary description of the plant

Built on a peninsula of 20 ha, the Tailfer plant basically comprises the following parts :

1. The water intakes in the Meuse : two pipes running out 20 m into the river bed; at the end, two grilles stopping gravel and floating objects; these two intakes are completed by a third lateral intake.

2. The feeder station : after a first filtering (2 mm meshes) the water goes to be treated.

3. The pre-ozonization building.

4. Storage, preparation and injection of reagents : from the injection onwards (block A) the plant is divided into four modules; each module forms a distinct chain capable of treating 0.75 m^3 water per second (65,000 m^3 per day).

5. The pulsators, static clarifiers and filters (block B) : in this block are 3 treatment phases :

– flocculation – decantation – filtration.

6. The ozone production and injection building : in the final filtering phase, the water is oxydized through an intimate and rapid contact between water and air loaded with ozone.

7. Sterilization by sodium hypochlorite.

8. The reservoirs with treated water with a total capacity of 30,000 m^3 form a buffer between the treatment and pumping phases.

9. The plant for pumping treated water : it brings the treated water to the reservoir of Bois-de-Villers; from there, water flows to Brussels by gravity via Mazy and the reservoir of Callois, with a capacity of 120,000 m^3.

10. The control room and laboratory are in block C, facing the Meuse.

11. Sludge treatment : sludge coming from the washing of the filters or collected in the pulsators and static decanters is disposed of in containers after being thickened and desiccated.

Production

The Tailfer plant has a production capacity of 260,000 m^3 per day (4 modules of 65,000 m^3).

In 1995, 46 million m^3 were supplied.

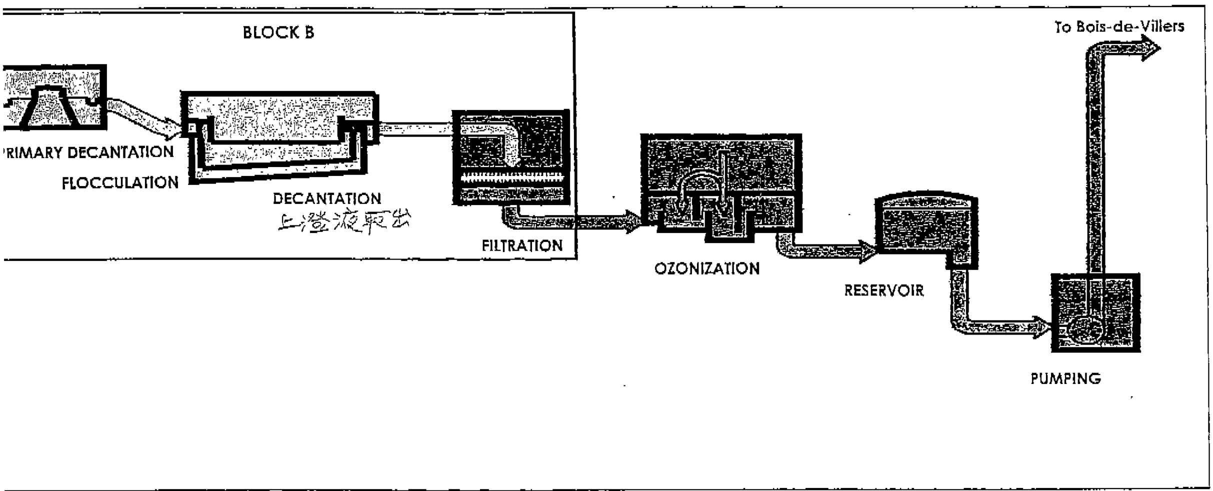
The plant had to intervene for 32 % in the total production of 140.4 million m^3.

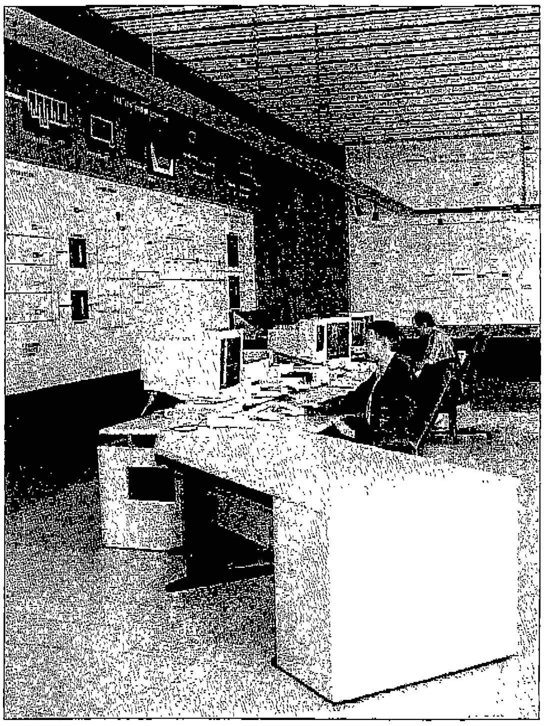
One aim : Water of an irreproachable quality

The Meuse water requires constant control and complete treatment.

It consists of the following stages :

- straining of the untreated water to eliminate the solid parts
- pre-ozonization of the untreated water





The control room

• water treatment by injection of the following reagents :

– aluminium sulphate for neutralizing the load of colloidal material floating in the water and for forming. agglomerates that ensure a decantation by gravity

– sulphuric acid for reducing the alcalinity

– activated silica used as a flocculation auxiliary

– active coal for perfecting the filtration and eliminating micropollution, bad flavour and odour

• flocculation of the water containing the reagents

• decantation of flocculated water

• filtration on a layer of finely crushed silex

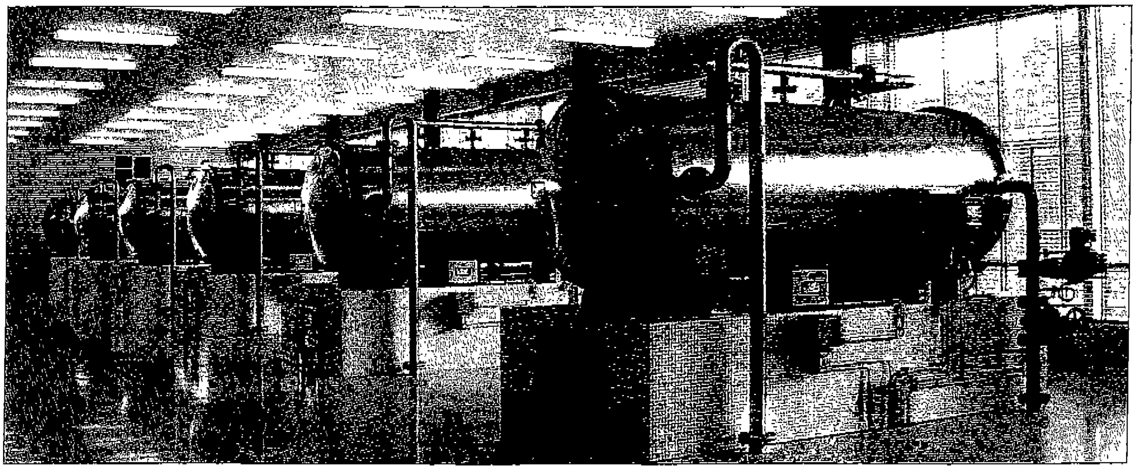
• adding of chlorine, used because of its oxidizing and bactericidal power

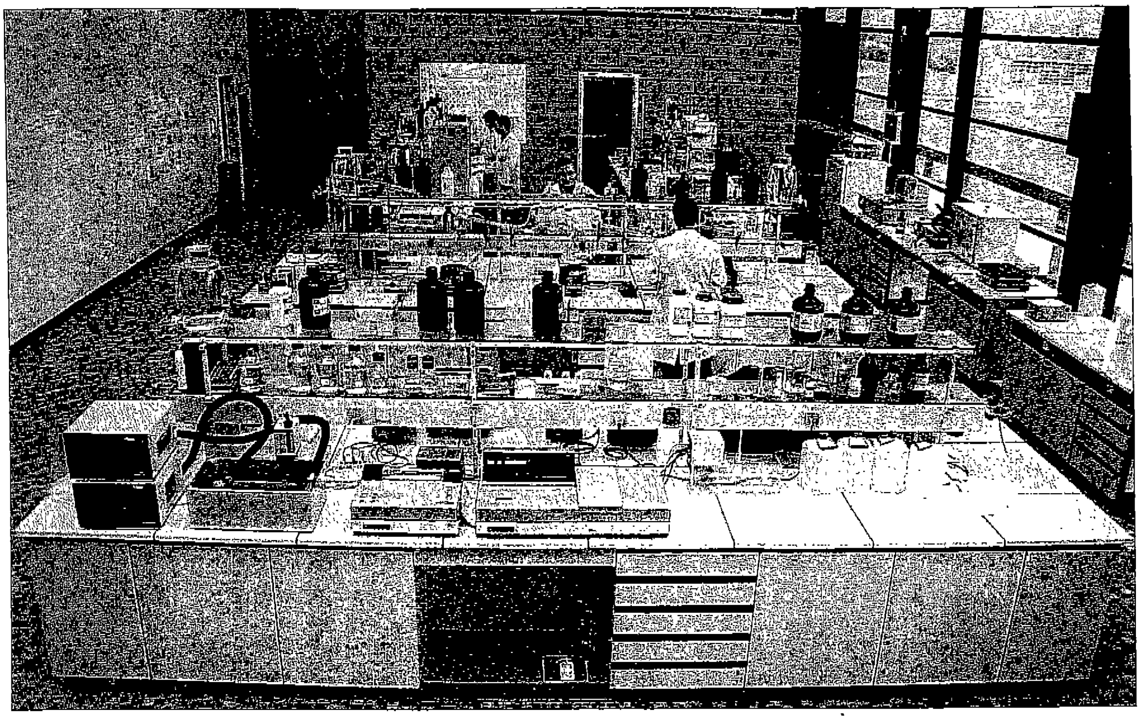
• ozonization for eliminating traces of micropollutants

• sterilization by sodium hypochlorite

• addition of caustic soda to neutralize the aggression that occurs because of the injection of sulphuric acid and aluminium sulphate

Room with ozonizers





View of the large laboratory room

The treatment chain makes it possible to produce potable water that is dependable, pleasant to taste and of a constant quality.

A supervision and permanent analyses of the river's water by the local laboratory as also an adaptation of the treatment to the «quality» of the untreated water are necessary. Indeed, the composition and temperature of the Meuse vary according to its flow, the amount of rain, the seasons and the behaviour of the riverside residents. It also is necessary to control the plankton and to constantly and attentively control the radioactivity.

Continuity ensured

All necessary steps have been taken so that the consumers are supplied with water under all circumstances :

- specialists in chemistry and electromechanics take turns every 8 hours, day and night, so that the complex runs efficiently
- all electromechanical and electronic equipment has been designed for maximum reliability
- if the power-supply system fails, a self-contained generating station of 4 x 3,500 kVa produces all the power needed.
- there are enough reagents to work for several weeks

A proven and developing production system

The Tailfer plant is one of 27 water catchment sites. Together with the supply network and the general installations of CIBE, it obtained the ISO 9002 certification, which is proof of the quality and professionalism of its production system. Nevertheless the system remains flexible and ready to adapt to any necessary changes. Hence a modernisation of the treatment process before the year 2000, which is currently taking place. This should provide a new plant, capable of meeting the severe standards of EU regulations, and more specifically, able to eliminate totally the pesticides currently found in the untreated water of the river Meuse. To achieve this goal, a biological filtration based on active coal granules will be established to complement the existing physico-chemical process.

COMPAGNIE INTERCOMMUNALE
BRUXELLOISE DES EAUX

CIBE

Compagnie Intercommunale Bruxelloise des Eaux

rue aux Laines 70
1000 Bruxelles
Telephone : 02/518.81.11
Telex : 61927 EAUWAT B
Telefax : 02/518.83.06

Turnover: 5 billion BEF (1993)
Staff: 1,339
Population supplied: 2,100,000
Annual production: 138 million m^3
(of which 63% is groundwater and 37 % surface water)

President :
Guy CUDELL

General manager:
Albert DESMED

Water supply

For the community, industry and private individuals

Function

As an administrative company, a public utility for water supply and a water producer, CIBE's task covers at the same time :

* activities that are primarily **technical** :

– a double function : research department and contractor;

– the operation of a general supply network with reservoirs, pumping stations, mains;

- the operation, spreading, maintenance and repair of all supply works located between the border of the operation zone of the municipalities or associations of municipalities and the entry of private dwellings and apartment buildings;

* **commercial** activities in the widest sense of the word : standing supply, sales policy, service and advice to the consumer, invoicing and collecting, financial balance of the activities;

* consideration for the **social** impact of these activities : action against the loss or wasting of an essential product, protection of the quality of the supplied water, maintenance of fire fighting equipment, appropriate tariffs...

Vehicles of the intervention teams.

Historical summary

1852 On 11th December, the municipal council of Brussels decided to organize the water supply in all parts of the City, both for public and for private use. In August 1854, the laying of the water supply network started. Work progressed fast and in 5 years about 142 km of pipes of different diameters was laid.

1897 In the Rue de Linthout at Schaerbeek, construction work started on a goods depot (workroom + garage) that would later become the Technical Centre.

1898 Completion of the work laying the first mains of the Company (reservoir of Boitsfort - reservoir of Schaerbeek - entrance of municipalities supplied) and of the first municipal networks (Ixelles, Saint-Gilles, Saint-Josse-ten-Noode, Schaerbeek, also Forest, Watermael-Boitsfort and Auderghem). Overall 76.5 km of ø 500.

1924 Establishment of a special department for meters.

1930 The network was divided into technical sectors adapted to the exploitation needs that no longer necessarily corresponded to the municipal limits.

Establishment of a collective emergency service instead of one for each municipality.

1932 The reservoir of Grande Espinette (high pressure) was put into service.

1933 After the merger with the Waterboard of Brussels, the supply network was divided into 3 supply zones : low, middle and high.

1936 The technical operating groups received listening devices for locating invisible leaks.

1938 A cover service (6-8 men) was created which operated on Sundays and public holidays.

1945 Almost unanimously the associated municipalities adopted uniform tariff regulations.

1948 A system was created to connect by radio the vehicles of the emergency service to the central station in the Rue de Linthout. A team specialising in detecting leaks was created.

1951-1955 The mains, previously under the roads were now put under the pavements.

1964 On 1st January, regulations to protect the water against pollution in the local networks were brought into effect.

1972 The supply network for the western part of Brussels (looping) was put into operation.

1973 The so-called «super high» supply zone was put into operation.

1980 The principle of a different tariff for so-called «industrial» consumers was adopted.

1986 In May, the General Assembly decided that CIBE should participate in the establishment of associations of municipalities for water supply. It was agreed that a management contract entrusting CIBE with the administration of these new associations would replace the previous agreements for local water supply with those municipalities, who would now join the new association of municipalities.

1988 On 24th February the «Intercommunale voor Waterbedeling in Vlaams-Brabant» was established; CIBE now runs its water supply service through a partnership concluded with the private company that manages this association of municipalities.

1989 On 30th June the «Intercommunale Bruxelloise de Distribution d'Eau» was established. An administration contract entrusted CIBE with the management of the water supply service.

1993 On 27th October, the General Assembly agreed with the conclusion of contracts with the «Intercommunale des Eaux du Centre du Brabant Wallon» (I.E.C.B.W.).

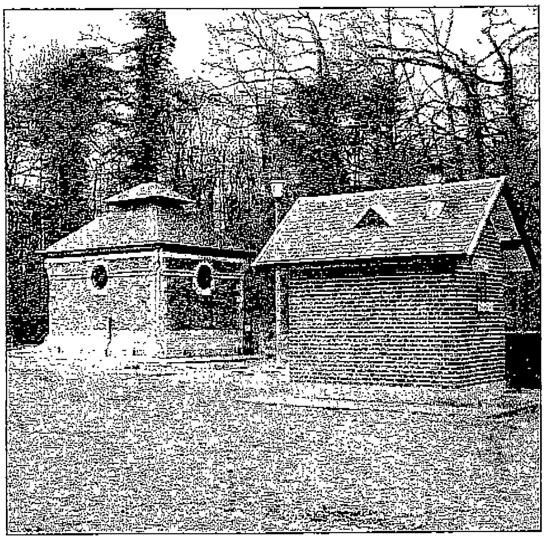
Technical description of the water supply

Infrastructure of the network

The water brought to the consumers throughout CIBE's supply network, flows into the network of the supplied area via the so-called «principal supply reservoirs».

There are 7 similar constructions with a capacity of 340,000 m3. Their main function is to control the incoming and outgoing flow. They also control the daily fluctuations in consumption. They are equipped with gauge rooms. In these rooms there is equipment to automatically record on diagrams which enables a constant reading of the supplied flow and there is also a system for measuring the volume available. The amount of the supply is adapted according to the data provided by this system.

That same information is conveyed to the central control room in the headquarters. There the staff can, when necessary, intervene in the process by remote control of the equipment.



Lodges at the Boitsfort reservoir.

Principal reservoirs

Name of the reservoirs	Capacity m³	Function
Callois (4 compartments)	120,000	Reservoir super high zone
Rode (3 compartments	75,000	Reservoir high zone
Boitsfort (4 compartments)	50,000	Reservoir middle zone
Uccle (2 compartments)	50,000	Reservoir for supply to TMVW
Ixelles (2 compartments)	19,000	Reservoir low zone
Etterbeek	18,000	Reservoir low zone (with delivery to reservoir of Ixelles and assistance to high zone)
Bois de la Cambre (2 compartments)	8,000	Reservoir middle zone
Total «Principal supply reservoirs»	**340,000**	

From these principal reservoirs, the water is brought, through a **distribution network** made up of so-called **«main-pipes»** to the supply networks belonging to the municipalities or associations of municipalities. These pipes, 217 km long, are in steel, sidero-cement, cast iron or asbestos cement and have diameters between 200 and 1500 mm. At the entrance of the municipalities or associations of municipalities, meters record the supplied volumes.

The entrance meters of the supplied municipalities or associations of municipalities form the starting point of the **supply networks.** These networks are the property of the municipalities in whose territory they are laid. They mainly consist of **mains**, pipes in steel, cast iron or PVC with a diameter between 40 and 600 mm and are 4,075 km long. They bring the water to the connections in private dwellings.

In certain areas, the network includes structures crossing canals, railways or main roads. All private dwellings have one or more volumetric meters. Their size is suited to the interior installations and they record the amount of water supplied.

Guaranteed pressure

The supplied area has a very varied relief between 15 and 35 m above sea-level.

It is important to have sufficient pressure at the high points and to avoid too high a pressure in the low points which would cause squandering and accidents. The supplied territory has therefore been divided into 4 zones :

* the **low zone** whose principal supply reservoir is located in Ixelles and strengthened by water pumped from the reservoir of Etterbeek

* the **middle zone** whose principal reservoir called «Boitsfort» is actually located in Uccle

* the **high zone** whose principal reservoir is located in Rode

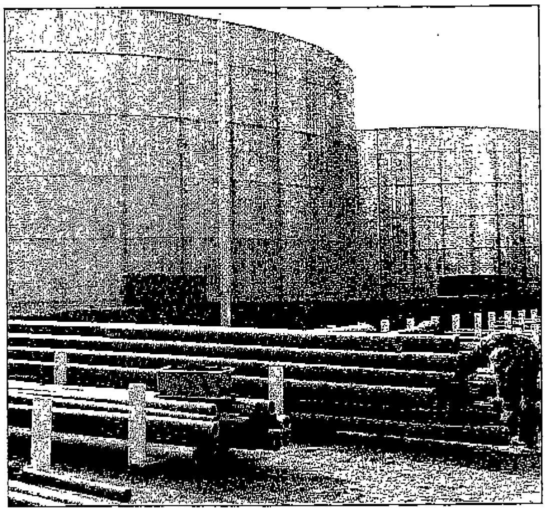
* the **super high zone** whose principal supply reservoir is located at Bois du Callois, in the territory of the former municipality of Lillois-Witterzée, now part of Braine-l'Alleud.

Between these different principal reservoirs, connection pipes have been laid to control the consumption in the various supply zones.

Certain municipalities, mainly located in the south of the supplied area, have special supplies, such as :

– direct intakes on the supply collectors (Ottignies, Wauthier-Braine, Halle, Waterloo, Braine-l'Alleud), sometimes with boosting equipment;

– local catchments (Ottignies and Zaventem) with pumping to water towers that are supply heads.



View of the reservoir in the Rue de Birmingham.

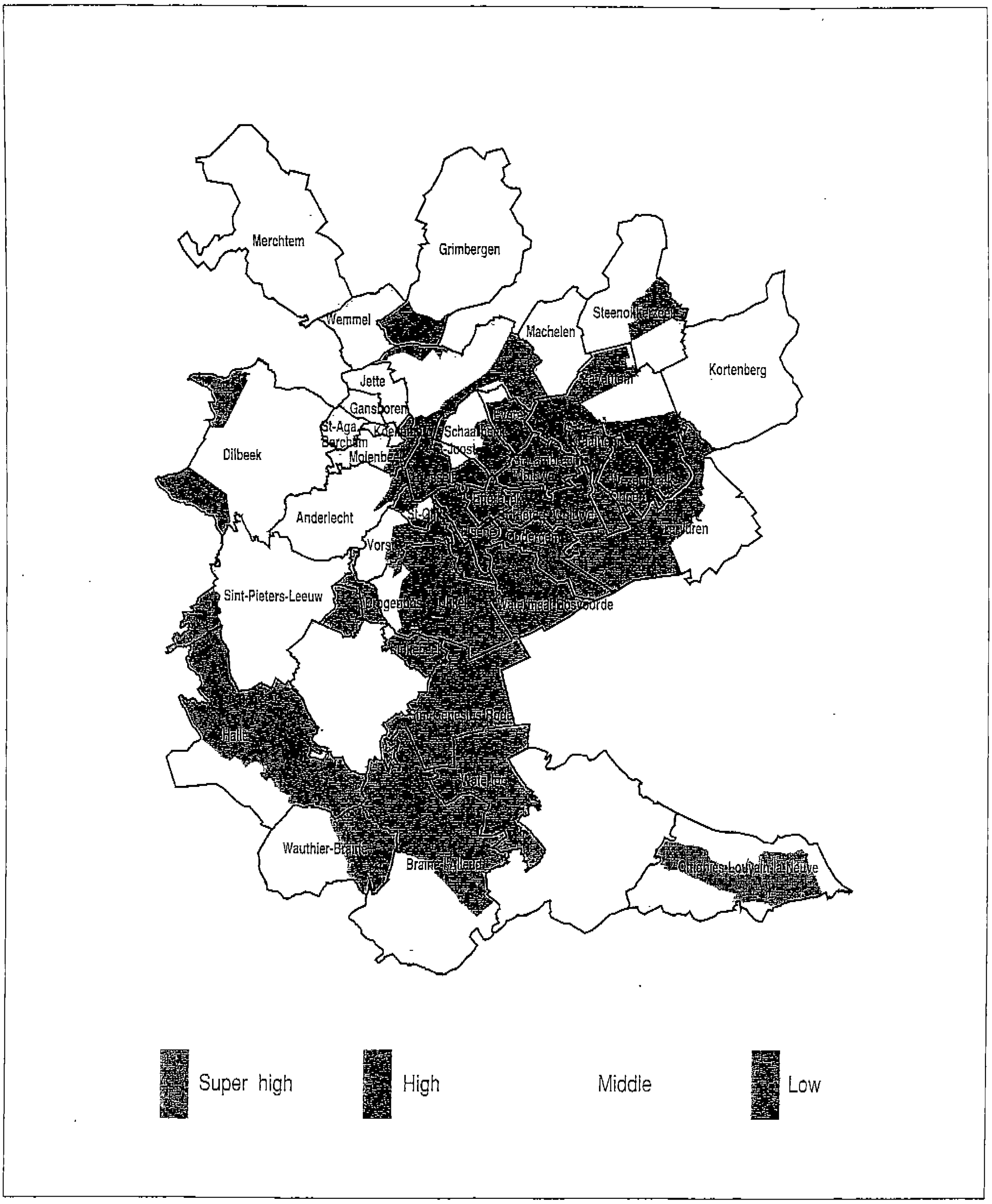
Cohesion of networks

Besides making connections between principal reservoirs, CIBE has for a long time made loopings between the different parts of the network. These enable the intensification of supply in case of increased demand at a certain point, for example fighting a fire.

In the distribution network there are also **so-called «downstream» buffer reservoirs.** They help solve temporary and local flow problems.

Downstream reservoirs

Name of the reservoirs	Capacity m³	Function
Mutsaard (4 compartments)	14,860	Reservoir
Birmingham (3 compart.)	16,300	Reservoir
Linthout (2 compart.)	15,000	Reservoir
Halle (Tuymeleer)	800	Reservoir
Ottignies (Blocry)	175	Water tower
Total «Downstream reservoirs»	**47,135**	



Supply zones

CIBE supplies water to the territory of 39 municipalities. Sometimes the supply is done on behalf of an association of municipalities (IBDE, IWVB or IECBW). The municipalities supplied are located in a hilly part of the province of Brabant between 15 and 135 meters above sea level.

To solve the problem of pressure variation, it was necessary to create several supply zones (low, middle, high) each of them supplied by one or more so-called «principal» reservoirs (located between the adduction network and the supply network).

Later (1974) a super high zone was added, supplied by a new reservoir (Callois) located in the territory of the former municipality Lillois-Witterzée (now Braine-l'Alleud), at an altitude of 162.5 metres.

By way of injections it strengthens the supply in the low zones.

CIBE, supplier of water services

Organization

For the management of the water supply service, CIBE acts as a service company on behalf of associations of municipalities (IBDE, IWVB and IECBW) or on behalf of autonomous municipalities.

In this respect, it has a triple function :

- as a **research department** it conceives projects for its clients for the eventual building, enlarging or adapting and maintaining of water supply facilities. Decision makers can then develop a programme and establish budgets;
- as a **contractor** who realizes programmes itself or with the help of subcontractors;
- and finally, as **operator** of the facilities when built.

In order to efficiently operate the facilities, CIBE divided its activity into **6 supply sectors.**

Each sector has a technical office with its own staff, warehouse and garage. There also is an emergency service operating 24 hours a day. It answers calls from sector vehicles or the central emergency service established in the Technical Centre of the Rue de Linthout in Schaerbeek.

The geographical decentralisation of the supply sectors is backed up by **central specialized sectors.**

Among these specialized units are :

* the unit for laying and maintaining the general supply pipes (distribution network)

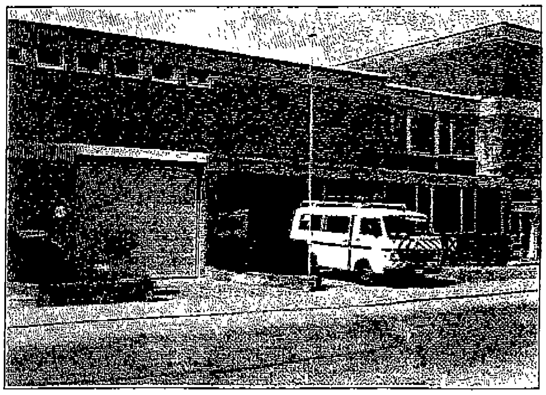
* the central emergency unit that can be reached by telephone 24 hours a day. It forms the nerve centre for controlling the networks of the supplied zone;

* the team for laying and maintaining electric installations and, more particularly, the pumping plants;

* the cathodic protection unit that plans, builds and supervises means for protecting pipes against corrosion caused by stray current;

* the meter repair shop. It maintains the meters and inspects them on average after 16 years for ≤ ø 40 mm and after 8 years for ≥ ø 50 mm;

The supply sector of Saint-Job



Night and day, the consumers can call a specialist of the Central emergency service.

* the team that systematically detects leaks in the network by means of acoustic and electronic equipment. This team also locates underground pipes and manholes under the road surface.

* the unit entrusted with the protection against pollution caused by back-flow of water. It draws up, diffuses and supervises measures and regulations to protect the water supply against contamination from the consumers facilities;

* the team that maintains the buildings and reservoirs.

Economic and social aspects

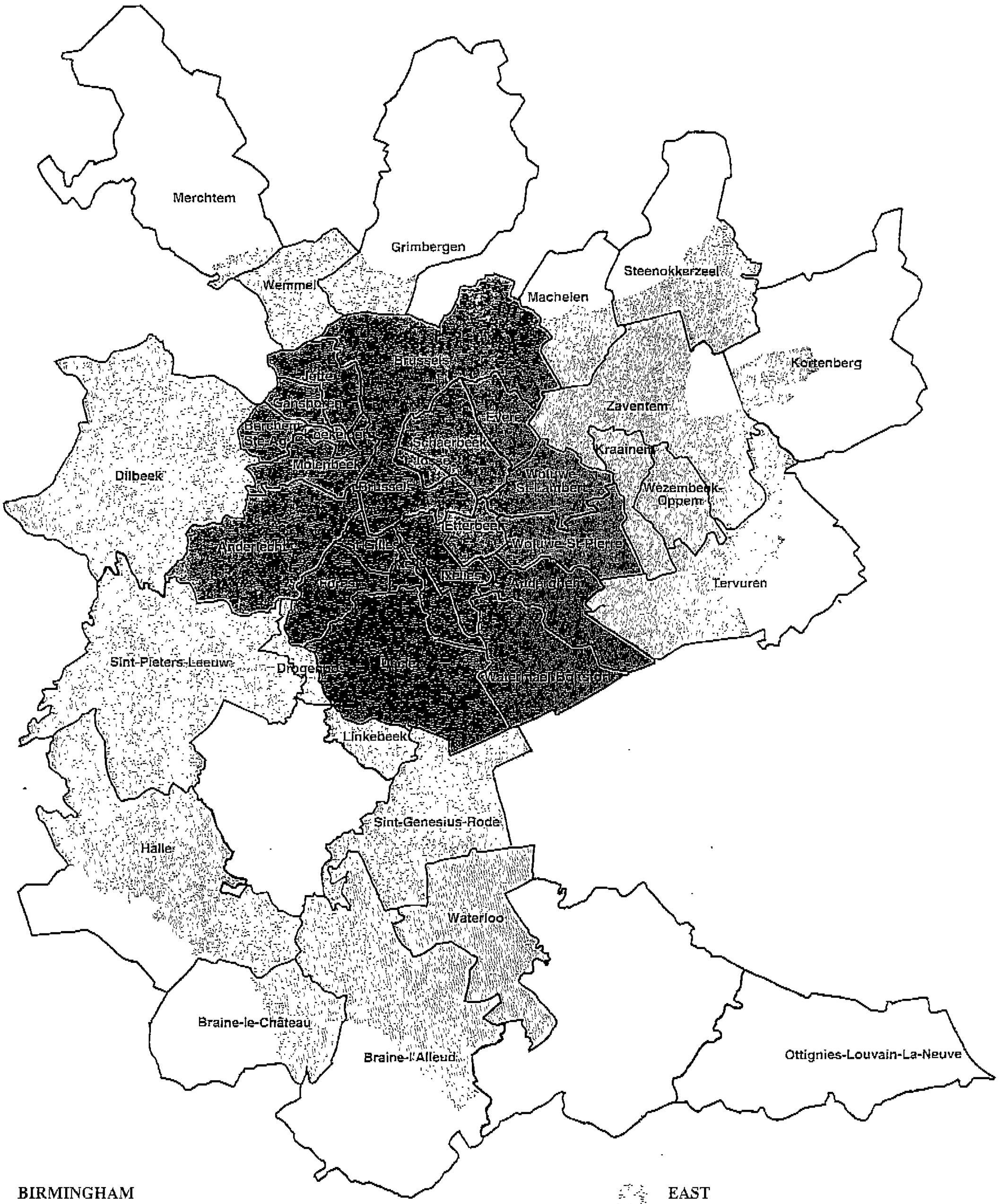
To obtain the maximum efficiency from the works and equipment and to enable their adaptation to the changing needs, CIBE has to obtain for its clients the necessary financing means; these clients are the municipalities or associations of municipalities, which entrusted CIBE with the running of their water supply service.

To obtain such important sums of money, the commercial policy of the management is very strict in order to maintain a sound financial balance throughout its activities. Nevertheless the social aspects of its policy decisions cannot be overlooked, in a field as essential as the public water supply.

The services are offered and the water sold to the consumer at tariffs that are first submitted for approval to the municipal authorities or to the administration organs of the associations of municipalities, then afterwards to the tariff department of the Ministry of Economic Affairs.

Those tariffs are actually applied through a biannual, annual, semi-annual or monthly reading of the amount consumed. A rapid invoicing and an efficient collection keep the unpaid amounts very low.

SUPPLY SECTORS



BIRMINGHAM
rue de Birmingham 120
1070 Bruxelles
tél. 523.41.58

LA VAU
chemin des Eglantiers 4
1420 Braine-l'Alleud
tél. 384.25.80

LINTHOUT
rue de Linthout 41
1040 Bruxelles
tél. 739.52.11

EAST
rue de Linthout 41
1040 Bruxelles
tél. 725.04.63

SAINT-JOB
ch. de Saint-Job 516
1180 Bruxelles
tél. 374.58.73

WEST
J. Dambrestraat 21
1600 Sint-Pieters-Leeuw
tél. 331.09.26

Supervision of water quality

As at all other stages for bringing the water to the consumer, besides the precautions already taken upstream, the drinking water is regularly and closely watched in the supply circuit.

Numerous water samples are taken for analysis daily in different points of the networks.

When networks have to be enlarged or pipes have to be repaired, all necessary precautions are taken before the pipework is put in operation again (cleaning and sterilization).

Moreover, the new interior equipment of the consumers has to be approved before being put into service. This prevents the risk of material entering the supply network by decompression and possibly causing deterioration of the water quality.

In any event water is never supplied without it being perfectly safe for drinking.

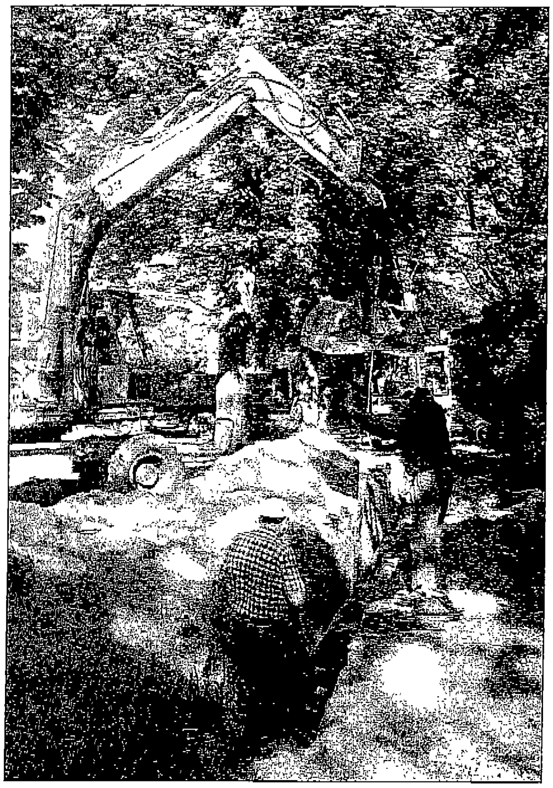
A modern organization at the service of the public, the municipalities and the associations of municipalities.

Our teams are experts where water is concerned. They have at their disposal technical equipment adapted to their working needs, powerful computer equipment and effective remote-controlled transmission equipment. These perfectly trained teams can guarantee an uninterrupted working of the water supply 24 hours a day.

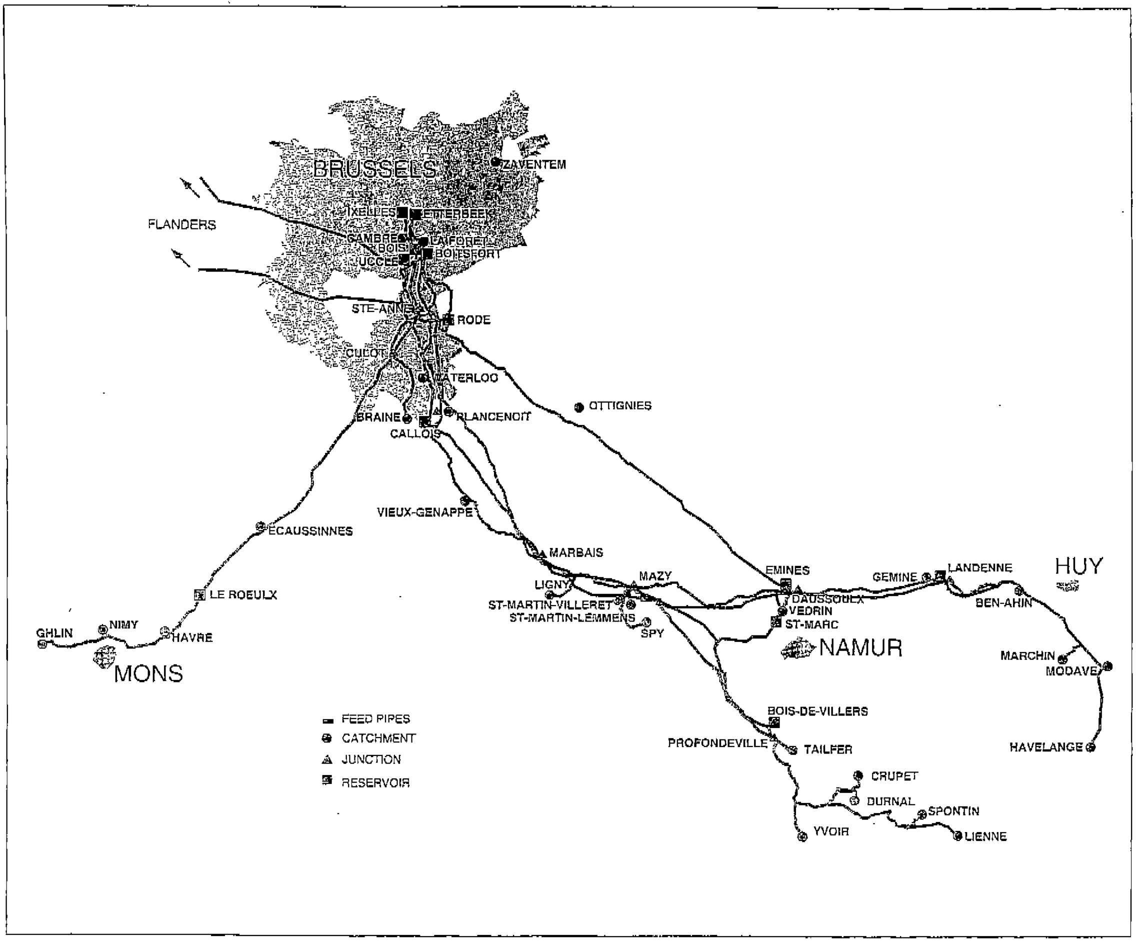
The sense of service and availability of its staff and its concern about quality greatly contribute to the general satisfaction of the users of the water supply service. CIBE ensures this service in accordance with the guidelines established by its commissioning municipalities or associations of municipalities.

A tight working spot.

Laying of main pipes.



Leak detection.



CIBE'S total production, transport and supply facilities

COMPAGNIE INTERCOMMUNALE
BRUXELLOISE DES EAUX

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Compagnie Intercommunale Bruxelloise des Eaux

rue aux Laines 70 – 1000 Bruxelles - Telephone : 02/518 81 11 - Telefax : 02/518 83 06

ISO 9002 - La production d'eau : notre métier

Catchments in Brussels sands

A safety measure for the capital

Function

First generation catchments established outside Brussels but as close to that city as possible.

Some of them were at the inception of the first «modern» water supply to Belgium's capital (1855).

Location

All these catchments collect water from the sand formation in the rather hilly part of the province of Brabant, south of Brussels : at Braine-l'Alleud, in Bois de la Cambre and Forêt de Soignes, at Plancenoit, Vieux Genappe and Waterloo.

Historical summary

1850 A careful study of the water supply in Brussels showed that collecting only local sources was not sufficient to guarantee a supply for the city

1853 On 30th April a royal decree decided that work to collect the water of the Hain sources in the Braine-l'Alleud region was of public interest

1855 On 26th September, the aqueduct bringing the water of the Hain sources to Brussels and the first compartment of the Ixelles reservoir, in which it had to be stocked, were ceremonially inaugurated in the presence of the King and the royal family

1860 All the works for setting up the catchments of the high and the low sources of Braine-l'Alleud are finished; the pumping plant of La Vau commenced operation

1862-64 Several sources of Braine-l'Alleud were running dry due to three successive dry years

1865 The municipal council of Brussels approved of a proposal to enlarge the water service by digging a drainage gallery at Braine-l'Alleud, later known as Lillois gallery

1872 The municipal council of Brussels agreed with the plan to dig a drainage gallery in the Forêt de Soignes; work started in April 1873

1875 On 18th June, a law ratified the agreement between the State and the city of Brussels giving the latter permission to dig drainage galleries under the Forêt de Soignes

1888 Work for digging the drainage gallery of Lillois was finished

1893 All the existing galleries under Bois de la Cambre and Forêt de Soignes were altered

1901 CIBE began to operate the catchment and pumping plant of Plancenoit

1904 Work started to dig the catchment gallery Les Hayettes at Braine-l'Alleud; it was finished in 1907

1930-31 A plan to enlarge the catchments in the Forêt de Soignes was studied between 1905 and 1928. The purpose was to replace the drainage galleries by filtering wells but the results of the study were disappointing. Therefore, several filtering wells were successively drilled in the Braine-l'Alleud region and in the Bois de la Cambre

Catchment of ~~the~~ Forêt de Soignes - Partition of the lake.

1933 The city of Brussels Waterboard and CIBE merged; the latter took over all the Brussels catchment facilities

A royal decree of 26th April authorized the realization of the project to collect source water at Vieux-Genappe

1935 The pumping plant of Vieux-Genappe began to operate

1953-54 At Waterloo a well was drilled and a catchment established

1970 Two collecting wells began to operate at Braine-l'Alleud

1972 The drillings for collection in the Bois de la Cambre were renovated

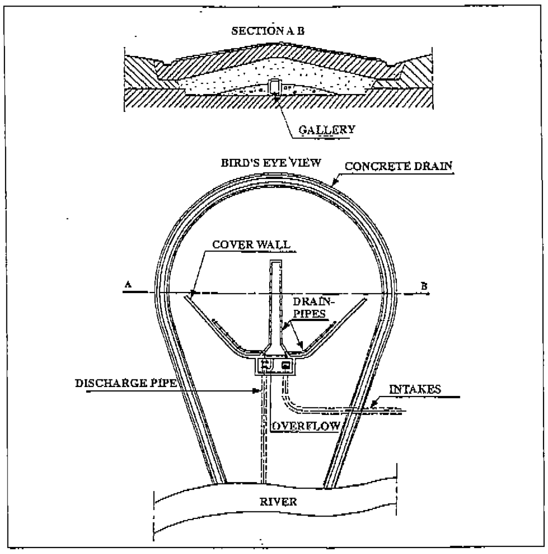
Description

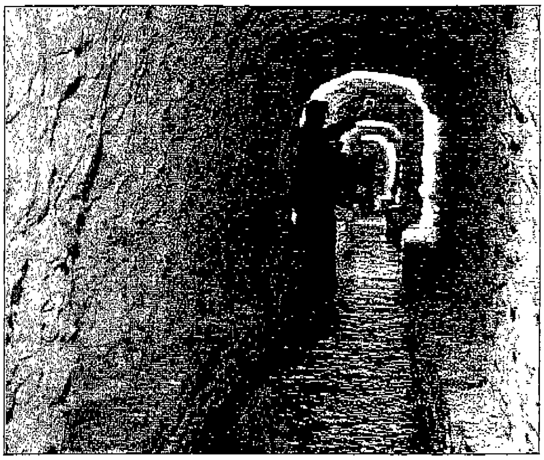
In order to collect the water sources in Brussels sands, the city of Brussels and/or CIBE use three methods that currently still coexist :

1. Collection of sources where they emerge

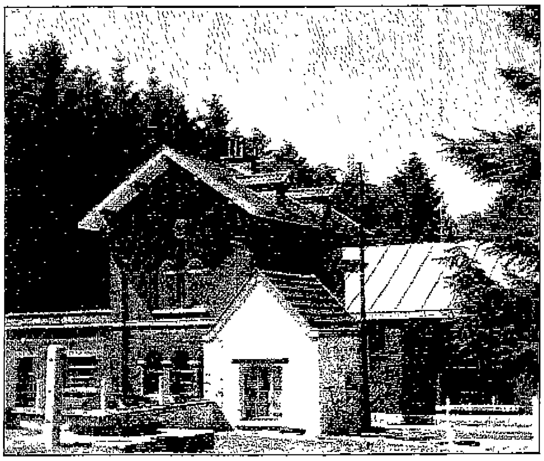
Sources are collected upstream from their emergence, by means of drainpipes of different sizes which are embedded in fine gravel. These pipes end in a chamber where the water is stored from where a watertight pipe brings it to a main.

That type of catchment can be found at Plancenoit and Vieux-Genappe



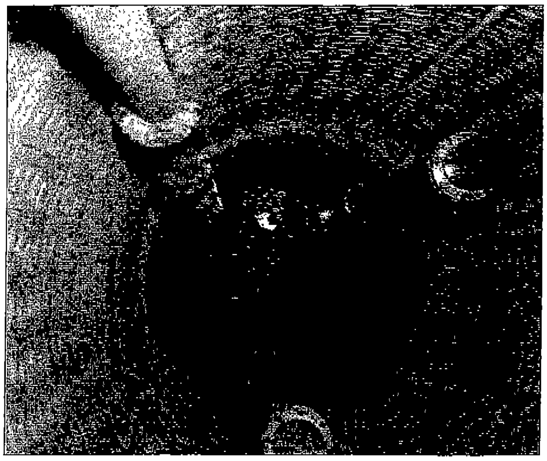


Braine-l'Alleud. Catchment gallery «Les Hayettes»

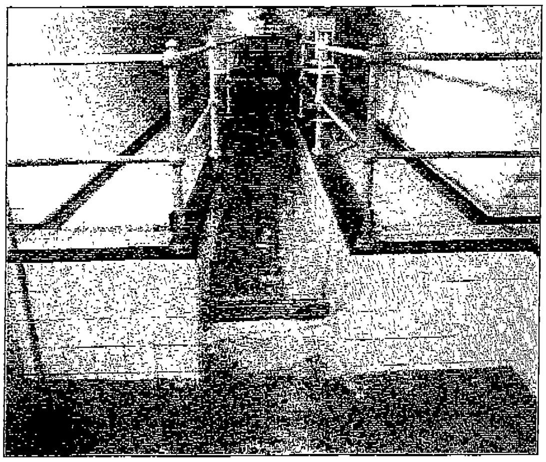


Braine-l'Alleud. Pumping plant of La Vau

Waterloo. Catchment well



Catchments of Braine-l'Alleud. Gauge of Lillois

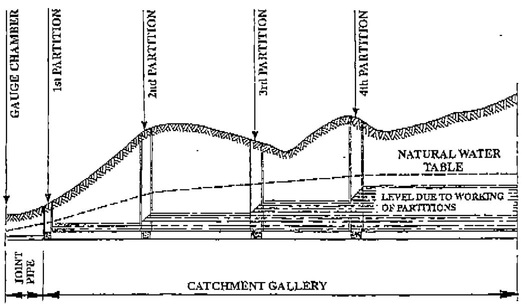


2. Collection through drainage galleries at great depth

This is the most common method; water is collected through drainage galleries dug out in the heart of the water table. These galleries can stretch over several kilometres.

In some places the galleries are sometimes dug out more than 60 metres underground, and lie about 18 metres under the natural groundwater table.

They generally have a rectangular section of about 1.80 m by 1.20 m. In the lower part are small openings that collect the water. This system enables the water table to be greatly lowered and to collect significant amounts of water. In order to increase their efficiency, most of the catchment galleries are equipped with underground partitions: the valves are located before or after a relatively long watertight pipe (up to 100 m) fixed to the ground by cement injections.



CIBE'S three largest galleries still in operation in the sands of Brussels are the ones of Lillois (4,300 m) and Les Hayettes (± 2,000 m) both located in the Braine-l'Alleud area and the one located under Bois de la Cambre and Forêt de Soignes, near Brussels (± 6,900 m).

3. Collection by wells or by drilling

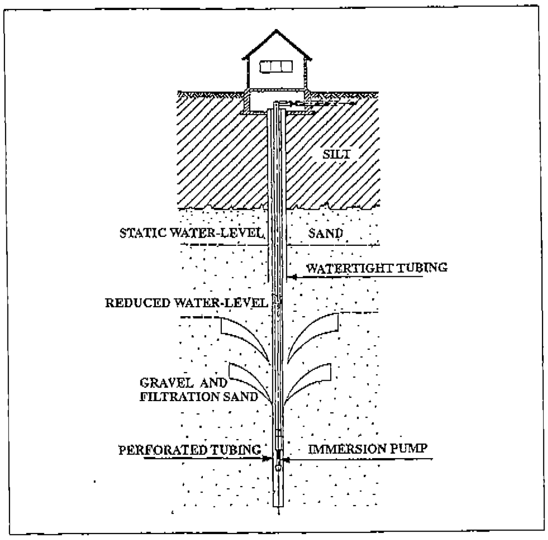
Among all the types of catchments used for collecting water in the sands of Brussels, this type of catchment is the last to be begin operating (1904).

Depending on whether it is drilled or dug, the catchment is called drilling catchment or catchment well. Their diameter and depth is also different. The interior diameter of drilling catchments varies between 400 and 1,000 mm, while it can reach 5 metres for catchment wells. Drillings can be 60 m deep, wells generally being less deep..

The casing above the water table is watertight; a significant number of holes in the part of the casing laying in the water table, enables the water to penetrate in it.

One or two carefully calibrated layers of gravel separate it from the ground and prevent fine particles from penetrating the wells. The wells are made of concrete, reinforced or not; while steel tubings, glazed sandstone or PVC is used for the drilling catchments.

In the wells or drillings are pumps for pumping the collected water to a transport pipe.



CIBE currently operates 22 wells and drillings in sandy soils. They are located at Plancenoit (1), Braine-l'Alleud (11), Bois de la Cambre (5), Vieux-Genappe (4) and Waterloo (1).

Capacity of the catchments

Most of the catchments described in this paper are at the origin of the first important development of the water supply system in Brussels.

Even though today they may no longer be the most important part of the supply system, in May 1940 when the second world war began, they had to act as substitutes to the temporary unavailability of important sources located further outside Brussels.The period necessary for the restoration of the normal supply could be faced thanks to the water reserves built up behind the underground partitions of the drainage galleries.

Today, the significance of their volume is limited but these catchments are still the ultimate safety measure for an emergency supply for the Brussels area, should a serious crisis arise.

Their cost being low, CIBE tries to have them working permanently.

In 1996 their total production was around 14 million m^3 or about one tenth of the total yearly production.

Each catchment can provide an average flow of 20,000 m^3 per day at Braine-l'Alleud, 6,000 m^3 in the Bois de la Cambre and in Forêt de Soignes, 7,000 m^3 at Vieux-Genappe, 3,300 m^3 at Waterloo and 2,500 m^3 at Plancenoit.

Water protection

All these catchments are equipped with suitable devices for preventing any unwanted infiltration of surface water : the drainage tubes are protected by layers of plastic soil, while the drillings and wells, as also the access wells to the galleries, are protected by watertight casings.

All these safety measures were gradually phased in by protection zones around the catchment sites. These zones are spread out in order to reduce every pollution of the water table.

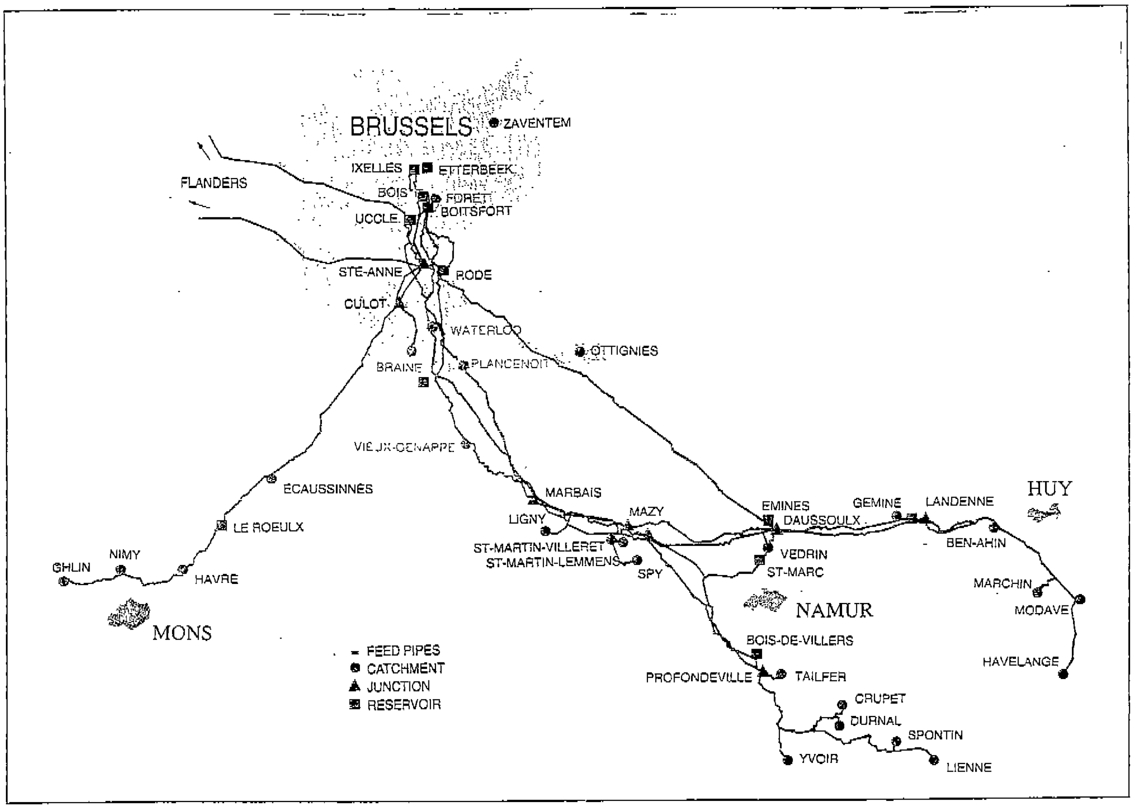
Supervision with care

Turbidimeters permanently measure the water clarity and automatically warn the central control room if there are any problems. Taste, odour and clarity of the water is tested twice a day by district surveyors. It is regularly analyzed by the laboratories.

Besides, CIBE watches over the zones located further away in order to prevent any pollution of the feed basin.

Naturally pure drinking water

Due to all precautions taken, the collected water remains naturally drinkable. It does not need any filtration or treatment. After straining, it has at most to be sterilized with chlorine so that it remains drinkable during its transportation. On its way to the consumption areas it undergoes different successive checks.



Location of the catchments in Brussels sands among CIBE'S total production, transport and storage facilities.

COMPAGNIE INTERCOMMUNALE
BRUXELLOISE DES EAUX

Install. 13,14,15,16,17 and 18 - Ed. 1997

Compagnie Intercommunale Bruxelloise des Eaux

C I B E

rue aux Laines 70
1000 Bruxelles
Telephone : 02/518 81 11
Telex : 61927 EAUWAT B
Telefax : 02/518 83 06

Turnover : 5.5 billion BEF (1994)
Staff : 1,400
Population supplied : 2,100,000
Annual production : 138.8 million m³
(of which 67% is groundwater and 33 % surface water)

President :
Guy CUDELL

General manager :
Albert DESMED

Catchments in the Basin of the Bocq stream

Crupet - Durnal - Sovet - Spontin

Function

By means of galleries in the hillside, water from sources is collected in the valley of the Bocq stream.

Location

Crupet and Spontin are located in the province of Namur, 15 and 20 km south-east of the city of Namur.
All the catchment galleries in this area collect water in the carboniferous limestone of the Condroz region.

Spontin. The Bocq stream at Reuleau.

Historical summary

1893 Approval of the project to acquire the sources of the Bocq at Sovet and Spontin (the purpose was to collect 30 to 35,000 m³ per day), to transport the water (82 km) and to stock it in reservoirs (Boitsfort and Schaerbeek).

1894 A royal decree of 11th July approved the agreements concluded with the municipalities of Spontin, Sovet and Durnal and gave CIBE the right to collect the water sources.

1898 Completion of the works for catchment, transport and storage (started by a private contractor and continued under our own supervision with the help of different subcontractors).

1st January 1899 the finished works for catchment, transport and storage of the water of the sources at Sovet-Spontin were put into service.

1902 A public utility decree of 14 November gave permission to start the works for collection and transport of the water from the sources at Crupet-Durnal.

1904-5 Successive completion of the works for catchment (May 1940) and transport (February 1905) of the sources at Crupet-Durnal.

Spontin. Primary catchment gallery.

Description

The sources that emerge in the calcareous rocks of the region are collected in so-called «main galleries», these galleries are dug into the hillside and drain most of the sources' flow.

So-called «secondary galleries» with a variable length and a reduced section overflow into the main galleries.

At Sovet-Spontin the main gallery stretches over 4 kilometres; at Crupet, it is 450 m long.

Capacity of the catchments

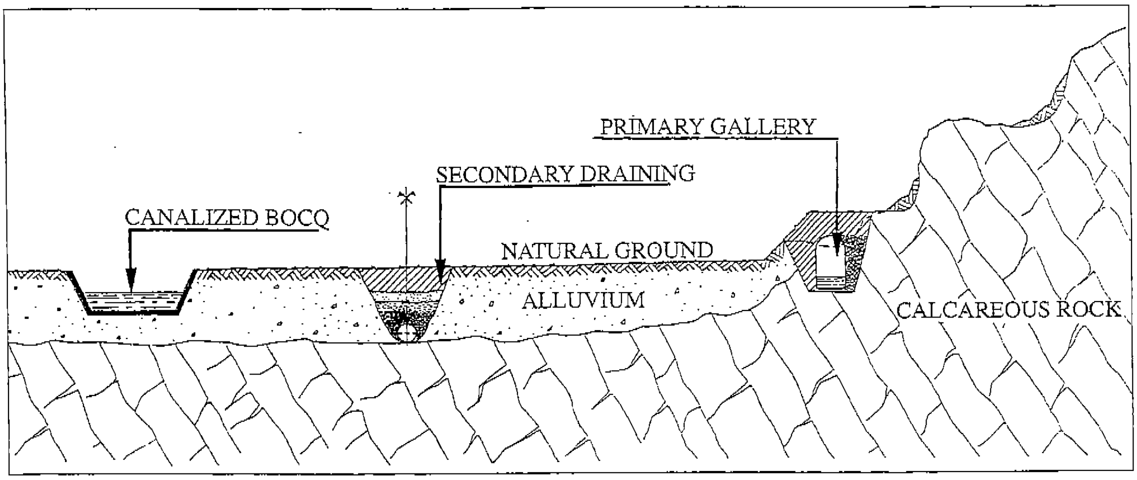
The catchments in that area are always operated to their maximum natural capacity. Since the abundance of water depends upon the weather conditions, these catchments deliver between 15,000 and 40,000 m³ per day at Sovet-Spontin and between 9,000 and 20,000 m³ per day at Crupet-Durnal.

Between 1989 and 1991, the production of the catchments was far below normal (the average daily flow was less 25%); during 1992 the situation seemed to become normal again.

Spontin. The Bocq stream converted into a canal around Senenne.

A natural protection

The calcareous layers in which the catchments of Sovet-Spontin and Crupet-Durnal collect water, are covered with a continuous muddy mantle. This external natural protection is completed by an internal filtration due to the material filling the cracks in the calcareous rocks. That material has been formed by weathering of the rock.

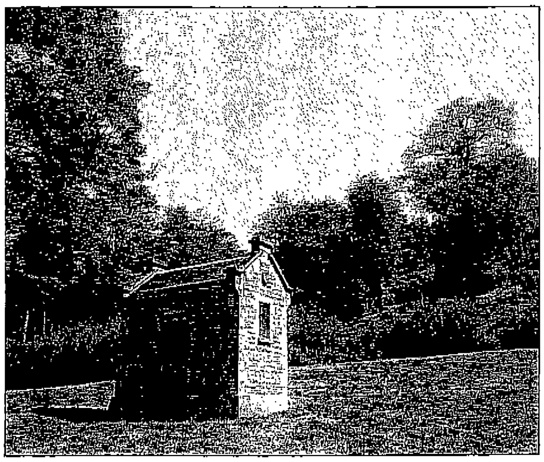


Spontin. Cross-section of the valley of the Bocq stream.

A preserved purity

CIBE prevented the deterioration of the sources by

- putting the primary catchments higher than the waterlevel of the river and the secondary catchments in the diverted and watertight bed of the river
- building gutters for evacuating any runoff which was too close or too concentrated
- not allowing in the catchment area any other activity than water production and intensive forestry
- buying vast plots of land around the catchments in order to effectively protect the water.



Durnal. Connection pavilion of the catchment.

A careful supervision

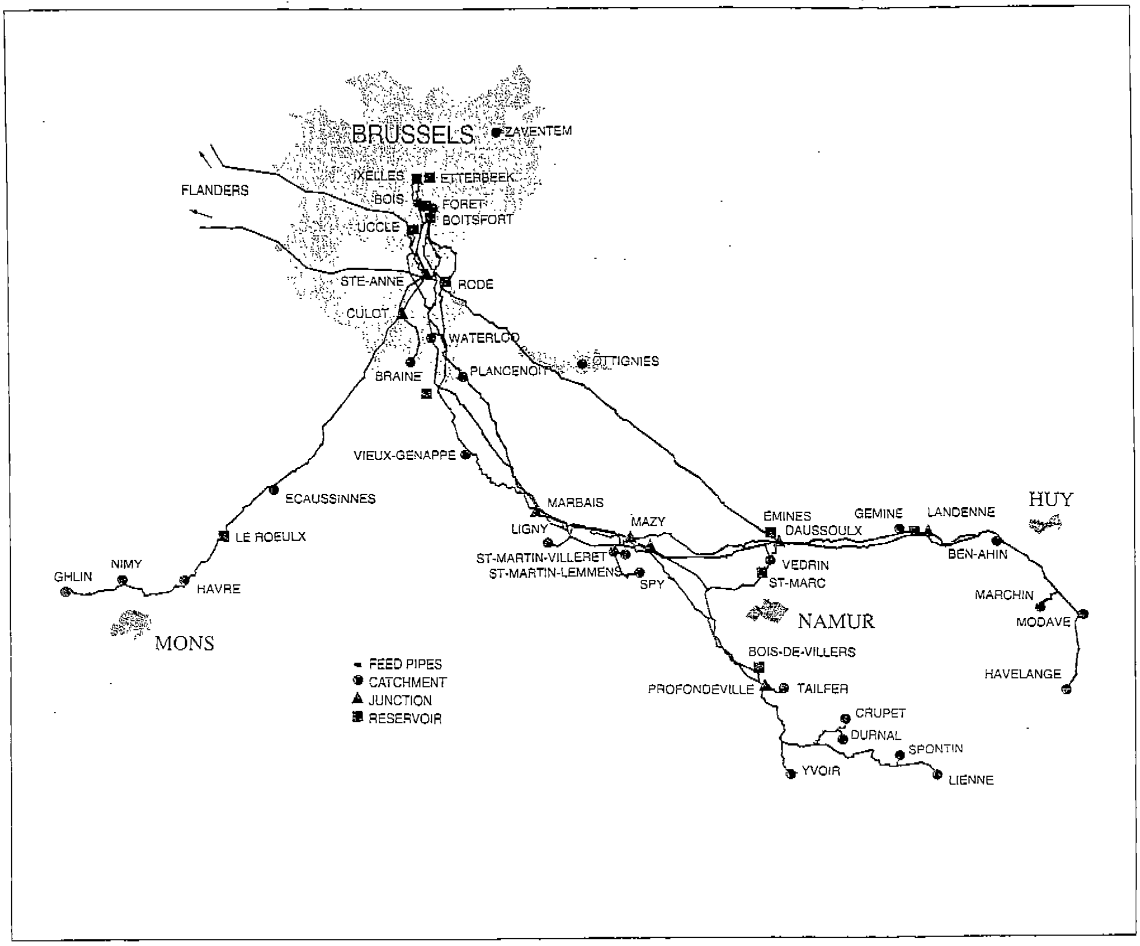
Photometers permanently measure the water clarity and automatically warn the central control room. Also, district surveyors test the taste, smell and clarity of the water twice a day. It is also analyzed by the laboratories.

In order to prevent any pollution of the basin, CIBE also supervises more distant areas.

Crupet. Altering the brook of Assesse into a strait to protect it against floods.

Natural drinking water

Due to all precautions taken, the collected water remains naturally drinkable. It does not need filtering. After straining, it has at most to be sterilized with hypochlorite so that it remains drinkable during its transportation. On its way to the consumption areas and also in those areas, the water undergoes successive checks.



Location of the catchments in the Bocq basin among CIBE's total production, transport and supply facilities.

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Installations n° 02, 03, 04 - Ed. 1995

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ISO 9002 - Water production : our job

VEDRIN

A mine full of water

The Vedrin plant: buildings at the surface

Function

Catchment, treatment and delivery of the pumpings of an old mine.

Location

Vedrin-Saint-Marc, 5 km north of Namur.

Historical survey

1910 CIBE collects water in the outflow gallery of the pyrites mine at Vedrin and pumps it to the feed pipe Spontin-Mazy-Boitsfort. This causes an increase in water supply to the capital.

1947 The mine is abandoned; CIBE comes to an arrangement with the Société Anonyme des Mines de Pyrites de Vedrin - which since became SAVENA -enabling it to dispose of the water in the underground facilities and to build all necessary facilities.

1947 to 1952 The facilities are gradually put into operation and finished.

Description

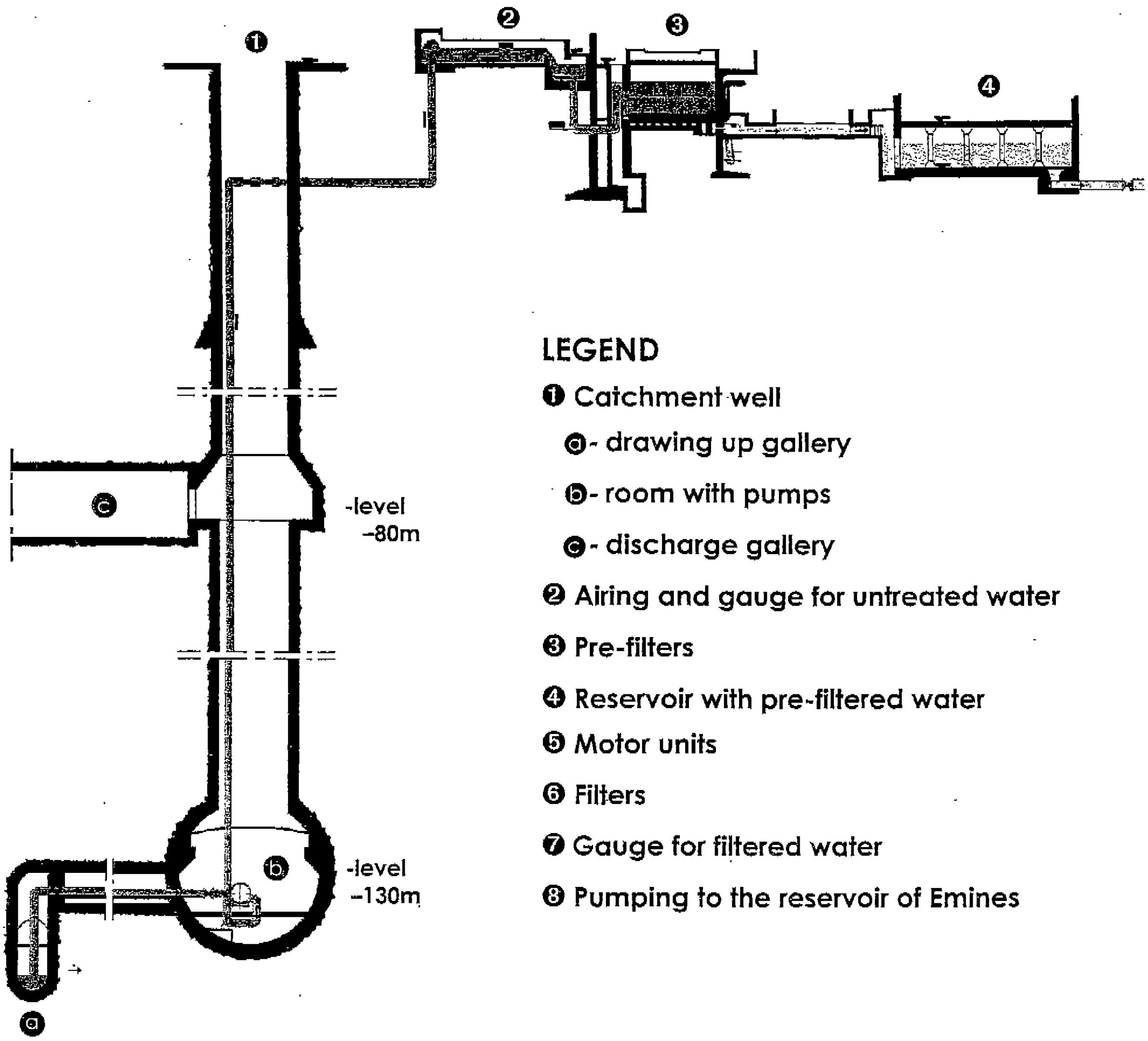
Catchment : the mine water is diverted to a pump room; access to this room is through a well 130 m deep, located about one hundred meter from the mine wells.

An underground dam separates this room from the mine. The catchment well (diameter 4.50 m) houses 6 delivery pipes, (electric) cables, a ladder compartment, a ventilation shaft and a lift.

4 groups of motor-driven pumps of 700 PK each, 2 vacuum pumps for starting them, 2 auxiliary groups for discharge of infiltration and cleaning water.

Buildings at the surface : the plant is T-shaped with 3 floors :

- cellars with pipes and regulating reservoirs;
- ground floor with filters, pre-filters, flow regulators, water collecting channels, channel for final gauge, engines of auxiliary pumping groups, blowers.
- floors : laboratory, offices, staff rooms.



LEGEND

❶ Catchment well

ⓐ- drawing up gallery

ⓑ- room with pumps

ⓒ- discharge gallery

❷ Airing and gauge for untreated water

❸ Pre-filters

❹ Reservoir with pre-filtered water

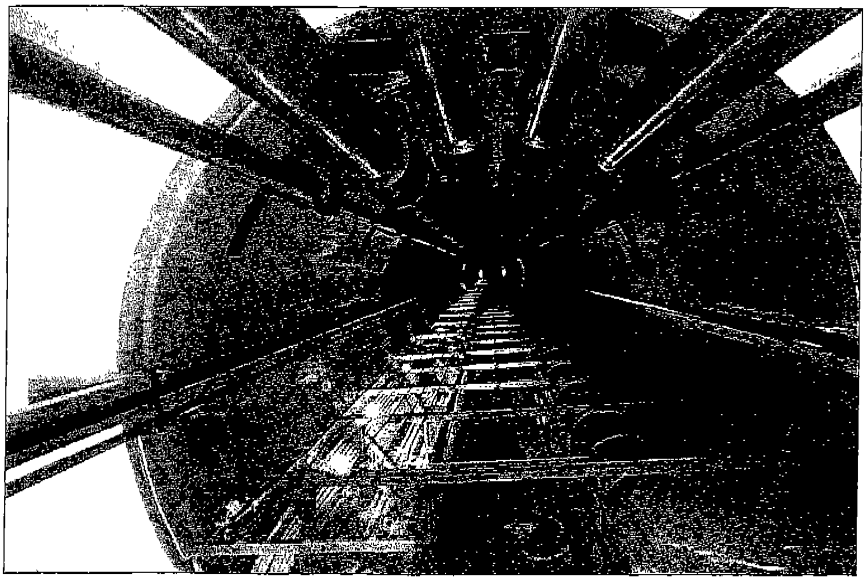
❺ Motor units

❻ Filters

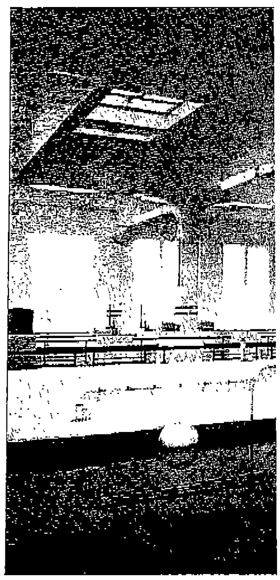
❼ Gauge for filtered water

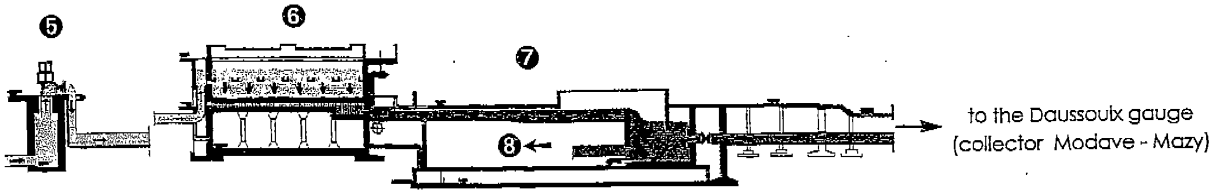
❽ Pumping to the reservoir of Emines

The catchment well



The room with pre-filters





Working scheme of the Vedrin water catchment plant

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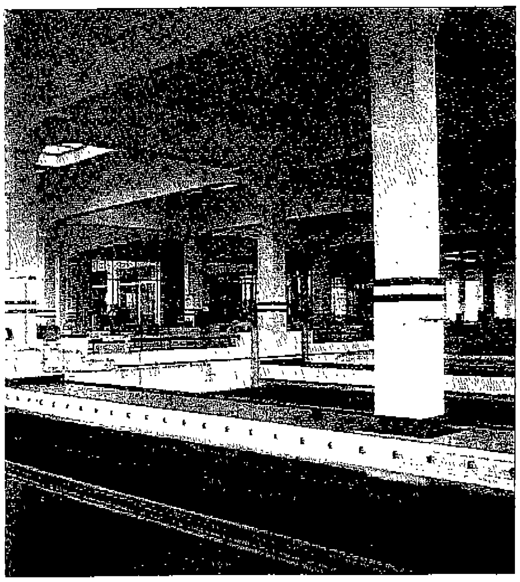
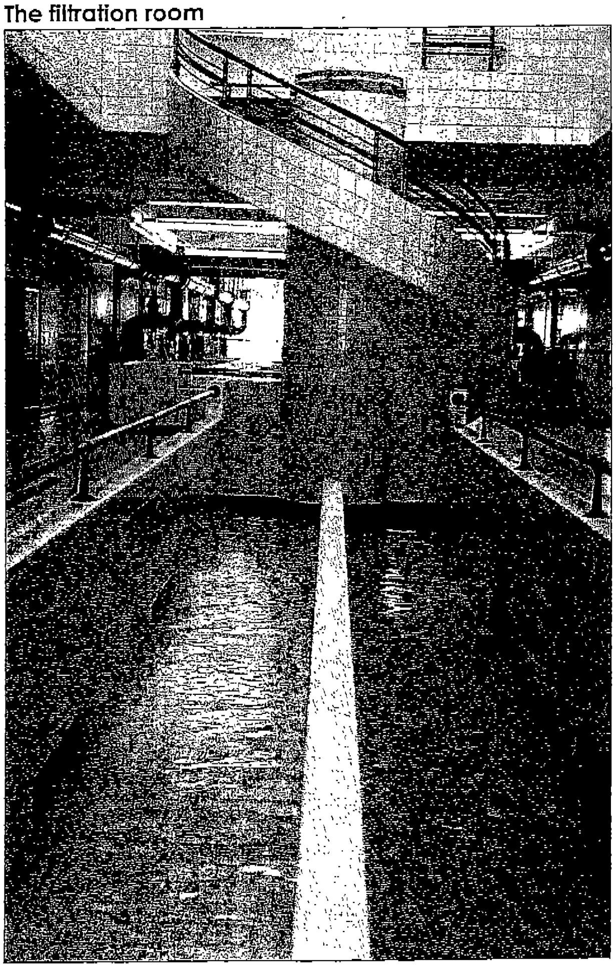


The filtration room



Miscellaneous : garage, warehouses, 10 dwellings for the operating and maintenance staff, decantation basins for collecting the water to be recycled.

Site

CIBE acquired more than 10 ha as a protection zone. Moreover, 8 ha are the property of the S.A. SAVENA.

Vedrin : elimination of iron

A real problem

Water from a layer containing iron inevitably has an unpleasant composition, aspect and taste. Before constructing any plant, CIBE therefore studied the treatment possibilities for a long time, first in a laboratory and afterwards in a pilot plant designed by its engineers. It enabled the development of a completely new method and the determination of the optimum dimensions of the final construction.

An efficient technique

The collected water goes successively through filters and pre-filters :

- in the 8 pre-filters of the open type, the untreated water flows downwards through a layer of 70 cm calibrated silex with a diameter of 1 to 2 mm. The automatically controlled velocity is 10 m per hour;
- in the filters, also 8 in number, the filtering material is a layer of finer calibrated silex (0,5 to 1 mm); the pre-filtered water flows through it at a velocity of 5 m per hour;
- sterilization with sodium hypochlorite.

A constant control

All monitoring equipment is located in a control room. It completes the continuous inspection by specialists. The water is controlled at each stage and also all electrical and mechanical equipment, both at the surface and underground.

Crystal-clear water

Originally reddish-brown, the water becomes perfectly transparent during the treatment. Its iron content decreases from 3 milligramme per litre to 0.03 milligramme per litre in the drinkable water leaving Vedrin. This is due primarily to natural means.

Performances

1994 : 10,368,330 m3

1995 : 10,667,190 m3

1996 : 9,774,350 m3

The iron in the untreated water at Vedrin calls for a constant control, a strict corrosion maintenance and a careful treatment. Vedrin has been for CIBE an opportunity to gain specialist knowledge in those fields and to gain experience of both water and of mines.

Even though the catchment of Vedrin was built a long time ago, it remains an original and very performing plant supplying excellent drinking water.

Destination

The water collected in this peculiar underground location, flows to the collectors Modave-Mazy and Spontin-Mazy and to the feeder pipe Daussoulx-Brussels. In the reservoir of Saint-Marc a volume of 3,000 m3 is stored for the supply of the plant itself and of the surrounding municipalities.

A proven and developing production system

The Vedrin plant is one of 27 water catchment sites. Together with the supply network and the general installations of CIBE, it obtained the ISO 9002 certification, which is proof of the quality and professionalism of its production system.

Nevertheless the system remains flexible and ready to adapt to any necessary changes. A renovation and modernization of the electromechanical equipment is foreseen in order to adapt the Vedrin plant to the technological evolution and endow it with a central command and supervision station operated by data-processing equipment.

That modernization will be finished by the year 2000.

COMPAGNIE INTERCOMMUNALE
BRUXELLOISE DES EAUX

Installation n° 23, Ed. 1997

Compagnie Intercommunale Bruxelloise des Eaux

rue aux Laines 70 – 1000 Bruxelles - Telephone : 02/518 81 11 - Telefax : 02/518 83 06

ISO 9002 - Water production : our business

The feed pipe network

An integrated, vital and reliable circulatory system

Function

The feed pipe network brings the water from the place where it is collected and possibly treated, to the place where it is consumed.

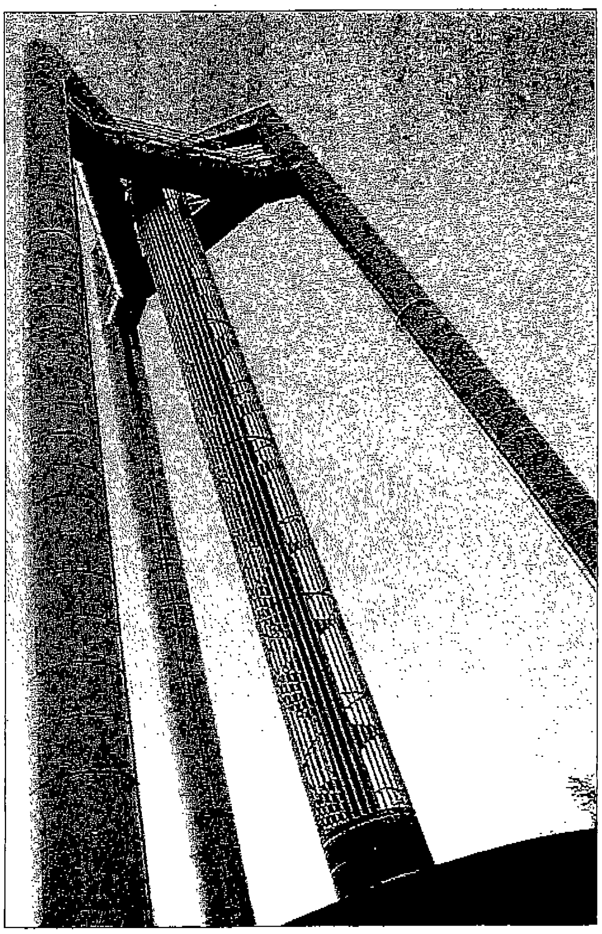
As the needs and the production equipment increased, this network became very complex and reliable.

In different strategic points of the feed pipe network, reservoirs store the available flow. They enable the adaptation of the supply to the fluctuations in demand.

The feed pipe network has been designed and functions as a perfectly integrated and coordinated system.

Location

Nowadays, the main feed pipe lines stretch over 497 km. They have their starting point in gravity catchments (Modave and Spontin) storage reservoirs or steering facilities and lie in five provinces (Brabant Wallon, Vlaams-Brabant, Hainaut, Liège and Namur). They all converge at CIBE's main consumption and supply centre, the capital and its surroundings.



The equilibrium tower of Mazy

Historical survey

1855 Finishing of the construction works of an aqueduct between Braine-l'Alleud and Ixelles (26,135 m).

1872 The municipal council of Brussels adopts a project to build a drainage gallery in the Forêt de Soignes; a new aqueduct will bring the collected water only to the lower part of the city.

1891 The Compagnie Intercommunale Bruxelloise des Eaux is established.

1899 On 1st September, CIBE puts into operation the catchment of Spontin, the collector Spontin-Brussels and the reservoir of Boitsfort; this reservoir collects the piped water.

1910 Two royal decrees from 19th March and 4th July authorize the construction of an aqueduct to bring the water of the Modave sources from Modave to the river Meuse and from the river Meuse to Mazy.

1914 The construction works, started in 1910, are stopped when war is declared; they are partially restarted in 1915.

1922 The aqueduct to bring the water from Modave to Mazy is finished on 1st May; it is put into operation on 30th June.

1932 The reservoir «Grande Espinette» and the collector Mazy–Espinette are officially inaugurated on 21st June.

1940 In May-June, the collectors are seriously damaged due to the war.

1954 The feeder pipe Ecaussinnes–Espinette and the doubling Meuse–Landenne are put into operation.

1965 The reservoir of Le Roeulx and the feeder pipe Le Roeulx–Ecaussinnes are put into operation.

1969
* the feeder pipe for doubling the collector Landenne–Mazy
* the feeder pipe Mazy–Callois

are put into operation.

1972
* the delivery plant of Profondeville and the reservoir of Bois-de-Villers
* the feeder pipes Tailfer–Bois-de-Villers and Bois-de-Villers–Mazy
* the feeder pipe La Vau–Culot–Uccle

are put into operation.

1973-1975 The feeder pipe Daussoulx–Emines–Espinette–Boitsfort is constructed.

1981 On 8th May, H.M. King Baudouin officially inaugurates the reservoir of Callois.

1993-1996 The feeder pipe Tailfer-Bois-de-Villers–Mazy is doubled.

Description

1. The aqueducts

The name applies to the oldest collectors in the feed pipe network. These aqueducts have a natural flow : due to the difference in level between their starting point and their end - there is a slope of 15 to 20 centimetre per kilometre - the water flows through them by gravity.

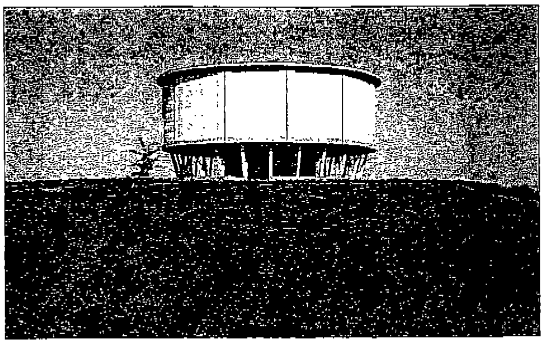
The collectors, with starting point Braine-l'Alleud, Spontin or Modave, consist of sections of aqueducts. When crossing the valleys, these sections are connected by delivery-pipes, the so-called «siphons».

The aqueducts are in masonry or in non ferro-concrete, are egg-shaped or rectangular and about 1.80 m high and 1.20 to 1.50 m wide inside.

The connection between aqueducts and siphons is made in pavilions called «siphon heads». Siphons consist of one or generally several rows of cast iron, steel or sidero-cement pipes.

2. The feeder pipes

The name designates pipes in steel, sidero-cement or prestressed concrete constructed in a more recent period (the first one Ecaussinnes/Espinette



Reservoir of upper Landenne

was built in 1948). In these feeder pipes the water is pressurized by means of feed-pipe facilities.

The water flowing through them, is secure from soil or surface infiltrations. They need less supervision or control but the fact that they are pressurized, requires the use of pressure pumps bringing about energy costs.

MAIN FEED PIPE LINES

	Nature and dimensions	Length in km
Feeder pipe Roeulx–Rode	Sidero-cement ø: 1.3 m	35.4
Collector Spontin–Mazy–Boitsfort	Masonry H: 1.8 m - L: 1.2 m	81.8
Collector Modave–Mazy–Rode	Masonry H: 1.8 m - L: 1.2 m	90.3
Feeder pipe Landenne–Daussoulx–Mazy	Steel ø: 0.8 m	28.0
Feeder pipe Daussoulx–Boitsfort	Prestressed concrete and steel ø: 1 to 1.2 m	50.5
Feeder Bois-de-Villers–Mazy	Prestressed concrete ø : 1.3 m	16.6
Doubling of feeder Bois-de-Villers–Mazy	Steel ø : 1 m	16.6
Feeder Mazy–Callois	Sidero-cement ø: 1.3 m/1.2 m	28.8
Feeder pipe Culot–Uccle	Steel ø: 1.1 m	9.4

3. The reservoirs

At the starting point or at the end of the feed pipes, or somewhere in between, reservoirs have been built for collecting and concentrating the water. Whichever is the case, the water is brought into the feed pipe network - we speak of «feed reservoirs» or into the distribution network - in which case we speak of «distribution reservoirs» (see table hereafter).

The main axes of the feed pipe network end in one of the reservoirs hereafter, downstream from the network:

* the reservoir of Ixelles (1855) which was the first reservoir where water was stored for the supply of Brussels. The water first came from the Braine-l'Alleud area and later (1874) from the Bois de la Cambre. This reservoir also collects the water compressed from the reservoir of Etterbeek (1878) where water arrives from the catchment in the Forêt de Soignes

* the reservoir of Boitsfort (1898/1903) : it originally collected the water coming from the Bocq basin;

later on it also collected the water arriving, by gravity alone, from the Modave area;

* the reservoir of Uccle (1914/1930) : it mainly collects water from catchments in the Braine-l'Alleud area. The water arrives by gravity alone after flowing through the intermediate reservoir «Noeud du Culot»

* the reservoir of Rhode-Saint-Genèse (1932) called «Espinette» or «Rode» : another reservoir that collects, like the reservoir of Boitsfort, water arriving by gravity alone, coming from the Spontin and Modave areas through old aqueducts

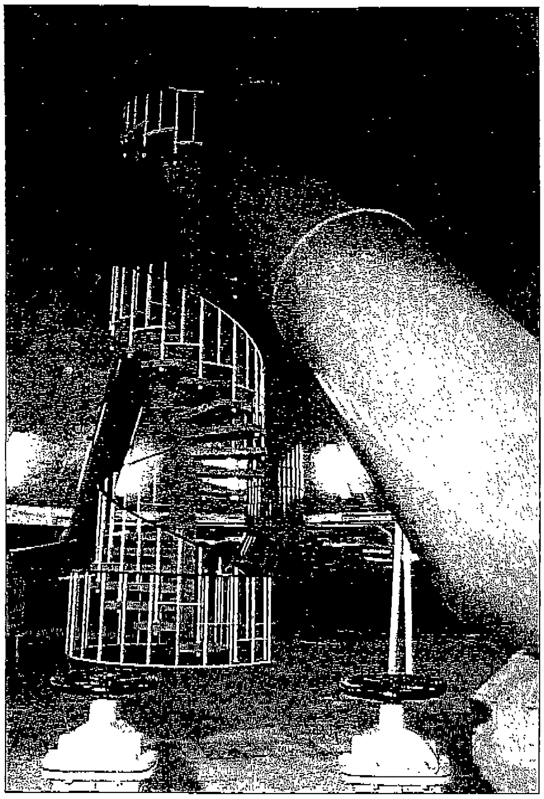
* the reservoir of Callois (1981) the key-stone of the supply network in the superhigh pressure zone; the water coming from Tailfer arrives through the feeder Mazy-Callois.

The above-mentioned approach of the outcome of the feed pipe process is rather theoretical since it does not mention the numerous exchanges or mixtures between water of different origin or different destination that are possible in a complex network by means of interconnections. These interconnections were set up as the facilities for water production and piping extended. The plan at the end gives an outline.

STORAGE FACILITIES

		Content (m^3)
Feed reservoirs	Bois de Villers	2 x 24,450
	Emines	7,500
	Landenne	7,510
	Roeulx	2 x 20,000
	Saint-Marc	2 x 1,500
Distribution reservoirs	Birmingham	3 x 5,400
	Bois de la Cambre	8,000
	Boitsfort	4 x 12,500
	Callois	2 x 23,800
		2 x 37,500
	Centre Technique Linthout	2 x 7,500
	Etterbeek	1 x 18,000
	Ixelles	2 x 9,600
	Mutsaert	4,000
	• tanks	2 x 5,400
	Rode	3 x 25,000
	Tervuren	4,000
	Tuymeleer	650
	Uccle	2 x 25,000

The central control room



Interior view of the Emines reservoir

4. The special constructions

In addition to the mains and reservoirs, special constructions have been built at strategic points of the feed pipe network.

They temper the flow - the pressure - of the water flowing in the mains (**equilibrium towers**), or they help it to clear deep valleys (**siphons**) or divert it to storage areas or consumption centres (**regulation knots**).

Valves are installed along the feed pipe network to isolate certain lengths while «connection valves» enable interconnections to be made between water with a different origin or destination.

5. The central control room

The central control room in the headquarters is the remote control for the entire catchment, feed pipe and storage equipment. It enables remote interventions in the feed pipe network.

The central control room :

* coordinates the manoeuvres for the working of the different workings of the feed pipe network

* controls their operation from a distance

* immediately operates the necessary commands and adjustments in case of breakdown

* perfectly and economically operates the available resources, equipment and workings.

The transmission equipment exchanges information telegrams forwarded through a standing telephone network. The brain of the installation is a computer supervising these information exchanges.

Quality supervision

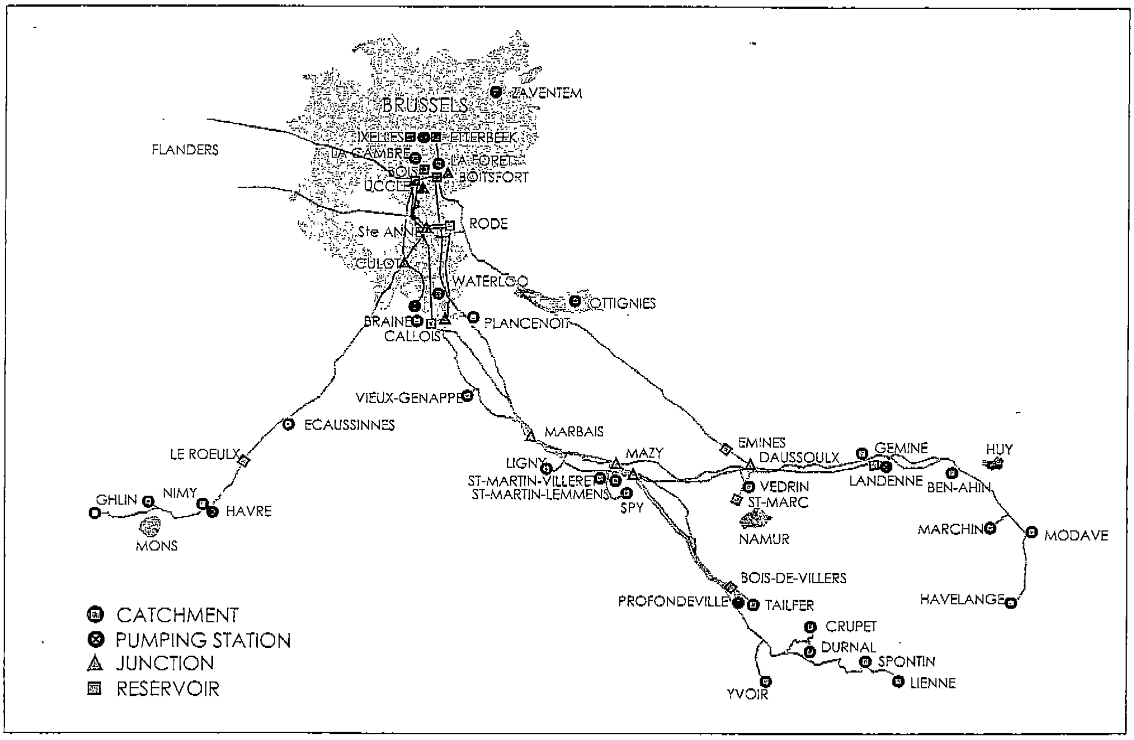
According to whether it is ground or surface water, precautions are severe and treatments thorough. Before bringing the water (through the feed pipe or supply network) into the consumption circuit, CIBE moreover applies a security system for guaranteeing the quality in all stages.

It means that the disinfectant ratio of the water remains constant, ensuring it a bactericidal power till the tap.

At certain spots along the water course, monitors check the absence of turbidity and measure the disinfectants, two quality indicators. Equipped with a reliable alarm system, they report locally and to the central control room, every abnormal turbidity of the water and/or every drop in disinfectant concentration. Every alarm sets off a procedure for taking the appropriate action.

Moreover, samples are taken on a regular basis - in some cases every day - in the reservoirs, gauges and pipes. They control the limpidity of the water, its absence of odour or colour and its chemical composition. The chemical composition is preventively controlled in the feed pipe network. Regarding the supply, the nature and frequence of the control is prescribed by the regional authorities.

In order to be able to control its feed pipe network and to safeguard it from any human activity that might endanger its integrity, CIBE has from the beginning owned the ground in which its facilities are implanted.



CIBE's total production, transport and supply facilities

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