

As part of a larger design team, was either project or lead design engineer on wastewater facilities that involved design and major construction. For activated sludge, experience includes the design of aeration basins, biological selectors and aeration diffusers/blowers. With fixed film systems (trickling filter and rotating biological contactors) extensive experience in biological towers, plastic media and their support systems. Additional experience in natural system (lagoons), solids handling and secondary clarifiers.

Is a senior process engineer with extensive experience in facility planning and capacity setting. Well versed in activated sludge process design and comparisons and has significant experience in oxidation ditch and SBR design / operation. Has previously managed offices for national consulting firms and is a recognized expert in the areas of biological nutrient removal, trickling filter and rotating biological contactor design.

PROFESSIONAL EXPERIENCE

Mr. Harrison has over 30 years of experience in the study, evaluation, and design of wastewater facilities. His specialty area is in modernization of wastewater treatment plants, especially for nutrient removal and for enhanced process control. His unique professional development has ranged from teaching to regulator oversight, and from operator training to facility design. His expertise includes process design, system comparisons, and facility planning. He has previously managed offices for national consulting firms and is a recognized expert in the areas of biological nutrient removal, trickling filter and combined fixed film and suspended growth Systems.

PROJECT EXPERIENCE

Of the nearly 150 wastewater related projects completed approximately 36 projects progressed to the level of full design followed by construction and operation, The following is listing of the of design experience.

<u>Application</u>	<u># of Design Projects</u>
Municipal Activated Sludge	9
Municipal Fixed Film Related Systems	16
Industrial Waste Treatment	7
International or Pacific Rim	4

Representative projects which demonstrate areas of skill typically required include:

Activated Sludge Design

The following are representative activated related projects on which Mr. Harrison has provided services.

Oahu, HI. Evaluated alternatives for treating liquid wastewater for upgrading the 26 mgd Honouliuli WWTP to 52 mgd with full secondary treatment. The evaluation included a full array of secondary treatment alternatives ranging from trickling filter to selector activated sludge. The study resulted in a staged design which will phase out existing trickling filters and eventually result in a new selector activated sludge treatment facility. John conducted process design on a step feed activated sludge unit. Work included modeling of the activated sludge plant with a focus on aeration equipment.

City of Winston, OR. Served as the Project Manager for initial studies through predesign of a 1.4 mgd facility that included both biological nitrification and phosphorus removal. His work included the design of anoxic and anaerobic selectors to encourage the growth of nutrient removing organisms.

City of Burbank, CA Project manager. Prepared capacity study, predesign and design for the upgrade of an 8.0 mgd plug-flow activated sludge plant to biological nutrient removal.

Makena Resorts, Kihei, Maui, HI. Project engineer on predesign and basis of design for 1.6 mgd extended aeration activated sludge plant for Makena Resort Corporation. New units include facultative sludge lagoons, UV disinfection and land application.

Fixed Film Related Systems

Provided engineering services on over 50 projects where fixed film (FF) reactors or combined FF and suspended growth (FF/SG) processes were involved. Of these projects 16 progressed to the point where services included support during facility design. The fixed film reactors he has worked on include both plastic fixed media and random cylindrical PVC media.

Has written operating manuals, conducted training seminars, or presented workshops in more than eight states and at several national and international conferences. He was selected to author or chair the following professional manuals of practice (MOPs) on fixed film systems:

- Chair/Author, WEF's specialty manual on *O&M of Trickling Filters, RBCs and Related Processes* (OM-10).
- Chapter Author WEF's specialty manual on *Aerobic Fixed-Growth Reactors*
- Chapter Author, *Manual of Practice for Wastewater Treatment Plant Design* (MOP-8).

The following are representative fixed film related projects on which he has provided services.

MCB Camp Pendleton, Oceanside, CA. Supported Naval Facilities Engineering Command design/build contractors in the rehabilitation of a 0.35 mgd trickling filter. Rehabilitation work included replacing rock filter media with plastic modules and a hydraulically driven distributor with a mechanical drive. Mr. Harrison's services included review of contractors submittals and evaluation of both filter media strength/type and rotary distributor flushing.

The City of Salmon Arm, BC. Mr. Harrison's services were retained to review and comment on a draft report after pilot studies were conducted at the City of Salmon Arm's 1.6 mgd activated biofilter plant. Comments were provided on flushing, biomass weight and cyclic changes from sloughing.

City of Tillamook, OR. Completion of a study, design and construction of a corrective action plan (CAP) ordered by the State of Oregon. Operational and facility changes were implemented to improve plant performance.

Beale Air Force Base, Yuba City, CA. Evaluation of modernizing a 1.5 mgd rock trickling filter plant to meet effluent reuse standards (CA Title 22) and stringent receiving stream standards. Issues included meeting new turbidity and stringent disinfection limits. The plant is being upgraded to a hybrid trickling filter solids contact facility with denitrification in the sludge reaeration flow stream.

Investigation of Plant Problems. Expert witness and forensic investigations have been completed by Mr. Harrison at both Kansas City, MO and Denver, CO. For the City of Kansas City Missouri, he investigated problems at a 60 mgd trickling filter plant, where a 150 foot diameter plastic media filter collapsed. At the 25 mgd TF/SC Plant Littleton-Englewood (near Denver), he investigated the collapse of roughing filter. His work included evaluating and providing opinions on media specifications and facility design.

Project Management of FF/SG Plants. Mr. Harrison served as project manager of the 15 mgd trickling filter and activated sludge plant at Turlock, California. He has served as both a design reviewer and as project engineer in predesign and planning activities for trickling filter or combined processes at the 14 mgd facility at Casper, WY; the 3.7 mgd Hillsboro, OR; and 8.2 mgd facility at Bremerton, WA; a 7.2 mgd facility at Muscatine, IA; an 11 mgd facility at Roseburg, OR (which involved several processes including TF/SC); and improvements to the existing Omaha, NE facility.

Project Engineer of FF/SG Plants. As lead engineer, he oversaw design activities associated with 2 combined filter and activated sludge plants for Frito Lay. Serving as subconsultant, he provided design expertise and oversight for the 2.6 mgd expansion of an existing rock filter at the U.S. Naval Station at Treasure Island, San Francisco, CA, including the addition of a new trickling filter with plastic-synthetic media.

Studies where filters were either constructed or improved with Mr. Harrison's principal involvement include: the 8.6 mgd combination of existing rock trickling filter media with new facultative lagoons at Montego Bay, Jamaica. His evaluation as principal engineer for the 30 mgd Willow Lake Wastewater Treatment Plant at Salem, OR resulted in the conversion of a pure oxygen activated sludge plant operated in parallel with rock trickling filters; to a series operated, conventional air activated sludge plant receded by rock trickling filters (commonly known TF/SC). His involvement as special consultant in preliminary studies in Tafila, Jordan, led to the construction of a 0.2 mgd TF/SC plant utilizing rock filter media.

Industrial Waste Treatment

As a consultant to the private sector, John has served 36 industries. Food processing clients have included: Ore Ida Foods (now Hines), Lamb Weston, Frito-Lay, Heublein and Hubinger. His textbook writing includes authoring over 100 pages entitled, "The Treatment of Waste from Fruit and Vegetable Industries." He has also worked on projects involving cannery waste from Agripac and United Frozen Foods.

The following are representative industrial wastewater projects on which Mr. Harrison has provided services.

Cannery and Frozen Food: Mr. Harrison's experience in the cannery and frozen food industry includes his being project manager of pilot studies and lead engineer in the design of wastewater facilities treating cannery plus

domestic waste for the City of Turlock, California. His work also includes the study of waste treatment facilities for cannery and frozen food waste located in Walla Walla, Washington.

Chemical and Petroleum: Mr. Harrison was project manager for two projects associated with chemical industry at Pacific Resins and Chemical in Eugene, Oregon. These projects involved BOD and nitrogen removal and overland flow application of treated wastewater. He also served as a project manager for the study of phenol removal from wastewater at the Simpson Timber Company plant located in Tacoma, Washington

Metal Finishing, Electronics and Hazardous Waste: In the metals industry Mr. Harrison has worked on the study of wastewater control and surface runoff for the Intalco Aluminum Corp. (located in Ferndale, Washington). This work included the preparation of a wastewater compliance plan for controlling site runoff of fluoride and other contaminants. He has also completed predesign studies of wastewater treatment facilities for the handling of domestic on-site wastes from Exxon's Los Bronces copper and molybdenum mine in Santiago, Chile.

Leather and Textile: An example of projects in the textile and leather industries on which he has worked is the operation of ultrafiltration pilot treatment facilities for handling of wastes high in oil and grease from Pendleton Woolen Mills, Portland, Oregon. He has also been project manager for studies on troubleshooting plant operations for the waste treatment and solids disposal of wastes from Frontier Leather Company, Sherwood, Oregon.

International or Pacific Rim

Project engineer on a number of design projects which ranged from a 6-month design project in Jeddah Saudi Arabia to numerous projects in the Pacific Rim, especially in Hawaii while serving a local Consulting firm on Oahu.

The following are representative international or pacific rim projects on which Mr. Harrison has provided services.

City and County of Honolulu, Waianae, HI (1996). Subconsultant on the upgrade of the 5.2 mgd primary treatment facility at Waianae to secondary treatment. Services included providing advice during facility design, writing of the operations manual and onsite training during startup.

Department of Navy, Apra Harbor, Guam (2008). Lead process engineer for a Department of Navy project on the repair and upgrade of a 4.3 mgd trickling filter solids contact plant serving a Navy base in Guam. Mr. Harrison worked closely with the design/build team to develop specifications and engineering drawings to rehabilitate the aeration blower system, replace trickling filter media and upgrade solid contact reactors.

Vancouver Metro, Vancouver, BC (2008). When it was necessary to add an additional trickling filter at the 21 mgd Lulu Island Wastewater Treatment Plant, Mr. Harrison's services were retained to provide an independent evaluation of filter media. His services included comparing the use of vertical filter media to cross flow media. Consideration was given to BOD removal performance and operating issues resulting from sloughing of biomass. As a result of the investigation, the Greater Vancouver Regional District selected vertical media for use in its new trickling filter.