RESEARCH HIGHLIGHT

Technical Series 01-112

Advancing the "Light Grey Option": Making Residential Greywater Use Happen

INTRODUCTION

Advancing the *"Light Grey Option": Making Residential Greywater Reuse Happen* is a research report commissioned by Canada Mortgage and Housing Corporation to investigate the feasibility of the "light grey option" for water reclamation in the home.

The "light grey option" is a new concept that has the potential to further reduce potable water use in residential buildings by 30 to 40 per cent after the introduction of state-of-the-art water-conservation equipment.

It proposes to collect used water, from the bath and shower, and rinse water from the dishwasher and clotheswasher. This treated water is reused for toilet flushing, clotheswasher and dishwasher washing, and outside irrigation.

The objectives of the research project were to investigate the concept with respect to public acceptability, greywater treatment requirements, and the availability of potentially suitable treatment systems.

RESEARCH PROGRAM

The project methodology consisted of an extensive literature review and obtaining pertinent information from various appliance manufacturers and domestic water and wastewater treatment suppliers. Initial contacts were also made with public and private utility companies, plumbing and mechanical contractors, equipment performance-testing laboratories, regulatory agencies and consumer organizations. The selection and design of an appropriate greywater treatment prototype was beyond the scope of the project.

FINDINGS

The literature revealed that the technological and engineering concepts of wastewater reuse are becoming increasingly well-understood and accepted. Experiences gained from municipal and residential reuse practices in North America and Japan are given as references with respect to a number of critical background considerations.

The benefits of wastewater reclamation fall into two categories: (1) supplementing available water resources; and (2) enhancing water pollution abatement.

There are two types of greywater plumbing systems used to achieve these benefits: Type A – two water supply and two drainage lines; and Type B – a single drainage network. The light grey option uses the Type A system with variations. To avoid mixing up the potable water piping and the greywater piping, or accidentally using greywater for potable water purposes, the greywater piping should be a different colour (purple) and made of a different material (PVC) than the potable water piping. Greywater used for irrigation purposes should be labelled "NOT FOR DRINKING PURPOSES."

It is important that developers of greywater reclamation systems gain acceptance from regulatory officials and the public. Consultation with regulatory agencies during the development and approval of water reuse projects helps to eliminate regulatory barriers, while gaining public acceptance.

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To be successful, the proposed light grey option must also satisfy a number of evaluation criteria. They include:

- product acceptability — the physical, chemical and microbiological water quality standards required for the operation of the appliances involved;
- reliability — the ability to consistently produce the required water quality;
- ease of operation;
- flexibility —responsiveness to variations in source water quality and quantity and varying use patterns;
- physical requirements —the ability to meet space and location needs;
- waste residual requirement — the ability to produce a minimum volume of waste products acceptable for final disposal; and
- affordability —affordable capital, operating and maintenance costs.

Greywater characteristics

The report also determines the probable greywater volume and chemical characteristics from a typical Canadian four-person residence equipped with state-of-the-art water-conservation devices. These include low-flush toilets and European-designed front-loading clotheswashers and dishwashers.

As a basis for sizing the necessary greywater treatment system, the report assumes two cases of water consumption. In Case (A), the light grey option assumes a total indoor use for a family of four of 705 lpd (litres per day) (41 gals. per day). In Case (B), it assumes 1400 lpd (308 gals. per day).

On average, mainly because it uses low-flush toilets, the light grey option will produce more greywater for reuse than is required within the home. The excess will be wasted before the greywater is treated, or it will be treated for seasonal irrigation purposes.

Greywater quality requirements

In terms of chemical, quality and health considerations, the quality of the greywater needed for use in the home is a critical consideration. While health concerns are minimal because the recycled greywater is not to be used for bathing or drinking purposes, precautions should be taken to prevent cross connections in the plumbing and inadvertent consumption. The greywater also requires disinfection to provide a public health factor and prevent biofouling in the system.

Greywater quality also includes appearance (colour and turbidity) and odour related to toilet flushing and irrigation. The treatment processes must be capable of reducing colour to acceptable levels. In addition, colour resulting from staining by trace metals or biofouling must be kept under control. Other concerns in the reuse of greywaters include unpleasant odours and volatile chemicals that may be given off. The treatment process should include aeration to drive off these emissions.

Homeowners would also have to monitor closely the use of household effluent for lawn and garden irrigation to prevent damage to plants from chemicals such as Boron, surfactant substances and sulphates found in household cleaners. They would also have to take precautions to minimize body contact — for example, by the use of in-ground irrigation systems.

Another cause of potential problems is the use of commercial cleaning products in the home. Heavy metals are found in laundry detergent, bleach, softener, dishwasher detergents, stain-prevention liquids, shampoos and bar soaps, as well as body soil and household substances on the skin. The report recommends that residents reduce their use of these products by substituting other products with minimal metal content.

Hazardous organic chemicals such as solvents, paint thinners and pesticides, would also have to be kept out of the greywater system. Organics come from cosmetics and personal-care products, and could appear in the greywater because of body and clothes washing. In these cases, discharge to the blackwater piping system is recommended.

Wastewater treatment processes

There are a number of wastewater treatment processes developers could use to constitute a greywater treatment system. These include:

- sedimentation in holding tanks;
- biological treatment methods for reducing dissolved organic matter to relatively low levels;
- rack filters to remove particulate matter;
- granular-media filtration for removing suspended solids remaining after biological treatment;
- recirculating filters to provide aeration and remove suspended solids;
- aeration and activated carbon to remove volatile organic compounds;
- membrane treatment such as reverse osmosis and ultrafiltration to remove all contaminants;
- disinfection by chlorination and ozonation;

- ultraviolet light to kill bacteria; and
- solar aquatics based on plants, sunlight and natural biota in the form of artificial wetlands and greenhouse systems.

The report also suggests that there are various uncertainties that will affect the ability to treat the light grey option and potentially suitable greywater treatment systems. For example, sedimentation may be ineffective in removing suspended solids, and biological processes may be ineffective in removing organics.

Greywater treatment options

An effective greywater treatment process must consist of some or all of the following components:

- storage before treatment;
- biological or physical treatment methods;
- disinfection;
- treated-water storage;
- protection against build-up of undesirable constituents;
- piping pump controls; and
- process redundancy.

Commercial equipment is available that could be incorporated into a treatment system. However, in most cases, it must be downsized for residential use. The following examples are provided.

The Clivus Multrum Roughing Filter and Soil Bed Treatment is one type of potential straining device. It is combined with a soil bed filter to aerate the greywater, thereby providing biological and physical treatment before the greywater is used. This process also requires greenhouse space to promote plant growth throughout the year.

AlasCan Biological Greywater Treatment provides an extended aeration treatment process, with the effluent usually discharged to a soil-absorption system. A polishing filter may be required for the greywater recycling application.

The Multi-Flo Waste Treatment System is another extended aeration plant for the treatment of combined wastewaters. Its single tank provides biological treatment and separation of the resulting solids by filtration.

The CABOS Wastewater Treatment System is a portable unit serving from 10-200 people for marinas, recreational-vehicle parks and construction projects. This system would have to be smaller for residential use, but it does have a number of desirable features for a residential greywater treatment system. It is also licensed to use powdered activated carbon – a means of odour, colour and toxic control that does not require the use of an additional activated carbon filter.

Cycle-Let Wastewater Treatment Recycling System is a complete greywater treatment system that uses all of the key processes available for producing a high-quality effluent. It would have to be redesigned to be smaller for use in individual homes.

Living Technologies for Solar Aquatics Technology uses marsh plants and microorganisms to treat wastewaters. It supplied an experimental system for the Toronto Healthy House, a demonstration home that uses rainwater and recycled wastewater to supply all its water needs. Once proven, this system would have the potential for direct application to residential greywater treatment under the light grey option.

CONCLUSION

Together with a CMHC Research Division paper entitled *"The Light Grey Option Paper on Domestic Water Conservation,"* this report offers sufficient information for potential developers to become involved in further advancing the light grey option.

The aims of any further development should be:

- to work with appliance manufacturers and the plumbing industry to deal with the plumbing requirements of the light grey option;
- to work with the domestic water and wastewater treatment industry to develop suitable greywater treatment systems for varying housing configurations;
- to work with equipment testing and regulatory agencies for the certification and approval of piping systems, appliance modifications and greywater treatment methods;
- to work with the housing industry to establish a variety of demonstration sites for practical, prototype evaluation under actual housing conditions; and
- to work with public health officials and consumers to win acceptance of greywater reuse in residential buildings as proposed by the light grey option.

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Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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