COUNCIL REPORT

HEPA AIR FILTRATION SYSTEM - EFFECTIVENESS, FEASIBILITY AND COST

RECOMMENDATION

That the June 7, 2022, Integrated Infrastructure Services report IIS01099, be received for information.

Report Purpose

Information only.

This report informs Council of the cost and feasibility of advanced air filtration within City facilities in the context of COVID-19 transmission.

Previous Council/Committee Action

At the February 11, 2022, Special City Council meeting, the following motion was passed:

> That Administration explore the effectiveness, feasibility and cost of installing HEPA filtration systems in City-owned facilities as a preventative measure against COVID-19, and include any site specific recommendations.

Executive Summary

- The City of Edmonton adheres to industry best practices of Heating Ventilation and Air Conditioning (HVAC) system design whenever building or rehabilitating City-owned facilities.
- Based on research, best practice and cost feasibility, Administration does not recommend mandated installation of HEPA filtration in City facilities' air handling units.
- There are no general area ventilation systems in City facilities that currently meet a HEPA filtration standard — upgrading to HEPA filtration was found to require a significant operational and capital investment as well as being logistically challenging or not feasible.
- Portable filtration is only recommended to be considered in spaces with low levels of ventilation and recirculation and a higher density of users that regularly turn over (e.g. classrooms). This equipment is best targeted to very specific facility spaces and operations.

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REPORT

The City of Edmonton adheres to industry best practices of Heating Ventilation and Air Conditioning (HVAC) system design whenever building or rehabilitating City-owned facilities.

Filtration of recirculated air can reduce the risk of infection by reducing the concentration of small aerosolized droplets. Supply air filters are installed as standard on most air handling equipment to improve indoor air quality and protect the equipment from clogging with dust and other debris.

A typical filtration strategy in building air handling units is to use two sets of supply air filters that process fresh, outside air, recirculated air, or a mix of both. The first pre-filters remove most large particulates and keep heating/cooling coils clean. The second set of final filters provides the desired level of supply air quality.

With this strategy, pre-filters capture the largest particles and need to be changed regularly. This protects the more expensive final filters, which can be changed every one to three years depending on the style and application type.

There are different levels of filtration, generally defined through the Minimum Efficiency Reporting Value (MERV) rating system. The pre-filters are usually in the MERV 8 category and the final filters are usually in the MERV 13 category. HEPA filters are tested to a different standard and do not follow the MERV rating scale. HEPA filters are more effective at filtration than MERV 13 filters. HEPA levels of filtration are normally used in two specialty applications.

- The first is when a dangerous contaminant is located in a single space (e.g. hospital isolation room). A HEPA filter system purifies the air being removed from that space and protects uncontaminated spaces. In this application, special filter change procedures are used to prevent maintenance staff from being exposed to contaminants during filter changes.
- The second common application is for cleanrooms, such as manufacturing sensitive electronic equipment, where even tiny amounts of extremely small particles can damage equipment.

Air filtration modelling has shown that the most significant reductions in relative risk of infection are achieved by upgrading filtration from any lower level to approximately MERV 13. Higher filtration levels, such as HEPA, typically provide marginal improvements in relative risk of infection while having significantly higher operating costs.

Industry Best Practices for Reducing Airborne Infectious Aerosol Exposure

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the leading industry standards organization for North America for heating and ventilation, has published a summary of emerging recommendations for reducing exposure to airborne infectious aerosols, which includes ventilation, filtration and air cleaning.

The ASHRAE recommendations for ventilation, filtration and air cleaning are as follows:

- Provide and maintain the required minimum outdoor airflow rates for ventilation as specified by applicable codes and standards.

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- Use combinations of filters and air cleaners that achieve MERV 13 or better performance levels for air recirculated by HVAC systems.
- Only use air cleaners for which evidence of effectiveness and safety is clear.
- Select control options, including standalone filters and air cleaners, that provide desired exposure reduction while minimizing associated energy penalties.

City of Edmonton Filtration Upgrade Potential

Due to their stringent performance requirements, HEPA filters must be used in specialized housings, which are extremely well sealed and have proprietary retaining systems not found in typical filter racks. Additionally, MERV-8 pre filters need to be installed upstream to protect the HEPA filters and extend their service life. To retrofit existing ventilation systems, new filter housings would need to be installed in return air ducts. In many cases, space in and around ventilation systems is very limited and modifications to other equipment and/or structures in or around mechanical rooms would be necessary to fit the new filter housings, making the retrofit costly and complex.

Adding HEPA filters into the return airstream also causes an additional restriction to the airflow. In some cases, the existing fan would need to be upgraded to accommodate this increase in resistance. For these reasons, retrofit of HEPA filtration into existing buildings is not feasible for some facilities and is expensive even when it is feasible.

An independent external feasibility study was commissioned in February 2022 to review potential filtration upgrades for five archetypal City-owned buildings: office tower, library, recreation centre, fire station and police station. The study provided insights on the required changes to the ventilation systems to support the addition of HEPA filters, as well as the challenges and constraints that can be anticipated, and finally, the cost implications.

- The capital cost to upgrade to HEPA filtration roughly ranged from $36,000 to $251,000 per air handling unit.
- Further costs would be anticipated for ongoing operations:
    - The average annual cost of the increased energy consumption is estimated at $5,000 per air handling unit (with an associated increase in GHG emissions).
    - The increased annual cost to replace HEPA filters is estimated between $3,400 and $4,800 per air handling unit.

The City of Edmonton has approximately 500 air handling units in its flagship facilities (a grouping of around 200 large, high-profile City facilities).

Portable Filtration Units

Portable air filtration units provide an alternative to permanent building systems to filter the air in a space. They can be used to supplement insufficient ventilation and filtration or for targeted use in high risk situations.

One major consideration for the use of portable filtration units is the type of mechanical system in place. For spaces with high ventilation levels, recirculated air and a small number of consistent occupants, portable units likely provide very little benefit for infection reduction. Spaces with low

levels of ventilation that utilize recirculation and have a higher density of users that regularly turn over (e.g. classrooms) are better suited for the use of portable filtration units. Only units with clear evidence of effectiveness and safety should be considered.

Portable air filters only mitigate aerosolized droplets as the larger droplets will not be drawn in by the unit. Portable filtration units should be placed with due care so as not to create air currents in directions that might increase airflow from an infected individual towards others and increase the risk of infection.

Next Steps

Based on research, best practice and cost feasibility, installation of HEPA filtration in City facilities' air handling units is not recommended. Instead, Administration will review, on a case by case basis and within existing resources, the feasibility to upgrade the air handling unit filtration to MERV 13, if not already at that level. Portable filtration units should only be used in targeted situations and evaluated by qualified personnel prior to installation.

COMMUNITY INSIGHT

Throughout the COVID-19 pandemic, Administration has solicited and listened to the perspectives of the community, employees and medical professionals. These perspectives informed the health and safety controls which minimize/minimized transmission to/from/between users of City buildings. To gain a specialized perspective from the HVAC industry, Administration worked with a local consulting firm to learn from their expertise on the current benchmarks and the advantages, challenges and uses of HEPA filtration.

GBA+

Indoor air quality within City-owned facilities shows a large correlation between contaminant concentration and occupancy density, however, there is little correlation between contaminant concentration and user level of privilege. This is largely because standardized building codes require a good ventilation design that treats spaces and occupants evenly.