UCRL 8784

UNIVERSITY OF CALIFORNIA

Ernest O. Lawrence

Radiation Laboratory

BERKELEY, CALIFORNIA

DISCLAIMER

for publication in Health Physics

UCRL-8784

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

HIGH EFFICIENCY AIR FILTER PITFALLS

M. D. Thaxter

June 1959

Printed for the U. S. Atomic Energy Commission

HIGH EFFICIENCY AIR FILTER PITFALLS*

M. D. Thaxter

Lawrence Radiation Laboratory
University of California
Berkeley, California

June 1959

ABSTRACT

Users of "high efficiency" filters for cleaning off-gases are advised against adopting an attitude of unquestioning faith in their efficiency. Field data supporting this advice is presented. Pleas for not only further development but also more critical field evaluation are offered.

*This work was done under the auspices of the U. S. Atomic Energy Commission.

HIGH EFFICIENCY AIR FILTER PITFALLS

M. D. Thaxter

Lawrence Radiation Laboratory
University of California
Berkeley, California

June 1959

The work of Langmuir, La Mer, Sinclair and others and the OSRD during the early years of World War II introduced for the first time an air filter with a claim to high efficiency removal of sub-micron particles. The best known result of this program was the Chemical Warfare Service No. 6 space filter. For several years this filter was classified "secret." Upon declassification, and following some minor development work and modification, this item was offered under the name AEC #1. Several commercial sources of supply have arisen. Meanwhile successful production of very small glass fibers, and papers thereof, made possible the development of a fire resistant all mineral high efficiency filter media whose physical and chemical properties were different from the CWS #6. The availability of these two types of filter media made possible air cleaning on a large volume basis and with reasonable cost at an efficiency unheard of a short while before. They have rendered a great help to health physicists, industrial hygienists and their architect-mechanical engineer colleagues in meeting their responsibility for decontaminating exhaust stack gases of quantities of radioisotopes.

The author offers the opinion that in some quarters a little too much enthusiastic faith and blind acceptance is now being shown towards these valuable air cleaning components. It is hoped that a brief review of the CWS-AEC high efficiency filter's shortcomings will tend to restore a salutary conservatism.

Many a process engineer today almost casually indicates disposal of contaminated off-gases on his flow sheet by the phrase "to CWS (or AEC) filters and stack." Some will even call them "absolute filters" which is dishonest nomenclature -- there is no such thing as a 100% filter.

In any event, this equipment may or may not do the required job, depending on many factors. Some factors are obvious, some are obscure, and some are not yet spelled out:

(1) The high efficiency filter will remove practically none of most gases.

(2) Its efficiency rating of 99.95% removal for 0.3 μ DOP liquid smoke says nothing for its capabilities on 0.02 μ material -- a size considered quite dangerous in human respiratory physiology.

(3) The nominal efficiency rating is only that measured at the factory, usually. Yet according to a communication from the Naval Biological Lab this value may be meaningless; it is the as installed efficiency which is realistic. Hardly any site is equipped to test filter efficiency in situ.

(4) Furthermore we and others have received mechanically defective filter units where media rips are visible to casual inspection. (slide: H. Pro. 639) An examination of stocks of filter units in AEC contractors' hands revealed defective units in every instance.

(5) The chemical vulnerability of these filters has been fairly well publicized. Technicians are quite familiar, generally speaking, with the notion of increased pressure drop with loading. One somewhat bizarre-appearing concept not well noted has been reported by Edgewood Arsenal personnel: it appears the all-glass media shows unfavorable time-dependency, as tested by DOP, exhibiting higher penetrations at 1/2 hour than at 5 minutes. This is an item worthy of more study.

(6) We hear rumors of agreement between theory and field data showing, in some situations, a shortening in high efficiency filter life because of the presence of pre-filters. This might, if true, become a very important design consideration.

(7) Another pitfall is the question of position of the filter in use. Usually it should be mounted with the pleats vertical. Horizontal mounting, infrequently required because of space limitations, is best made with the air passing upward through the media to negate in part the force of gravity tending to pull the media from the frame.

(8) In the author's view one of the most difficult problems connected with high efficiency filters is that of removal and replacement when loaded with dangerous radioisotopes. A number of attempts to "automate" such have been made with varying degrees of success. It may be timely if a review of these were prepared for future design guidance.

(9) The largest remaining pitfall, the solution to which appears at hand, is flammability. A combustible paper filter bank with forced air draft makes an excellent furnace; if the filters are radioisotope-laden the redispersal of perhaps months of collection may be accomplished in minutes with quite serious potentialities.

In view of the variable factors already discussed, the conservative will find it wise to take continuous downstream air samples. Unfortunately a number of users employing high efficiency filters take no such samples despite the AEC licensing provisions of 10 CFR 20. This Federal law requires each licensee using radioisotopes to secure data on exhaust air contamination at the point where control is relinquished -- usually the stack discharge. Here's an example of the kind of activity we recently found in a sample. We processed material with an activity of 2.8×10^{13} dis/min α. Included in the processing equipment was an air cleaning train involving a wet venturi, a wet pad scrubber and a five-layer dry filter, the last two layers being CWS #6 filters. Nearly 100% of the downstream air was passed through a millipore filter. 1×10^{5} dis/min of α-active material was found on it. This would, in many installations, have gone to the stack for discharge -- enough to contaminate a million or more cubic feet of air beyond MPC.

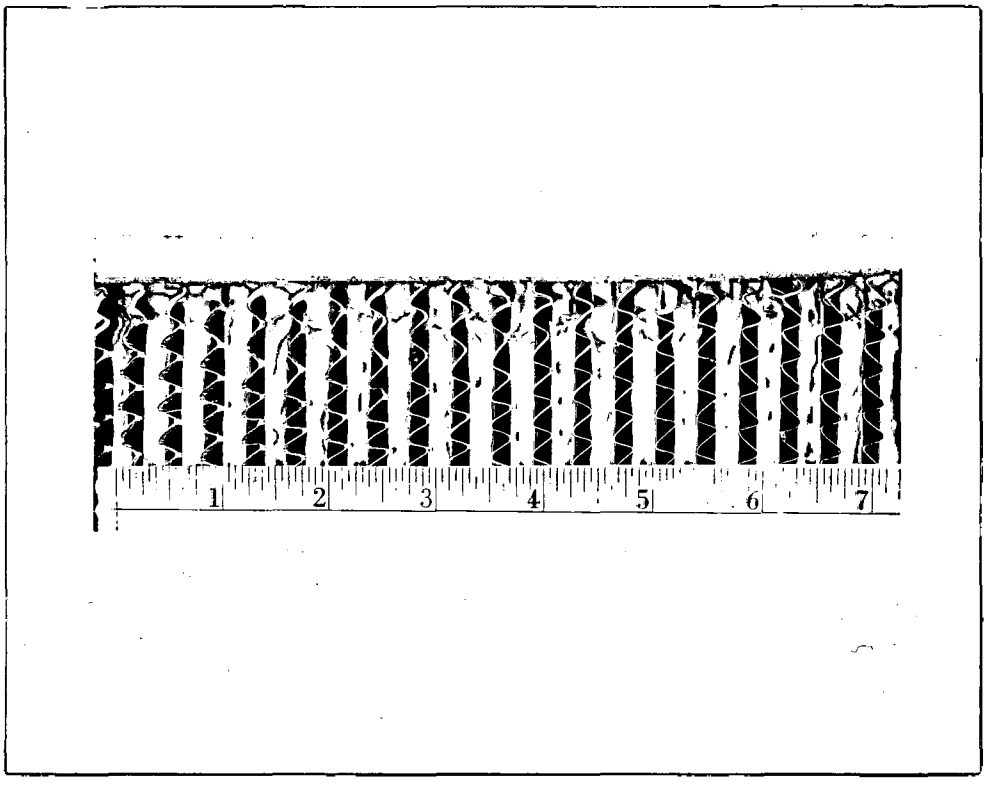

Fig. 1 (slide H. Pro. 639)