HW-24495

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May 16, 1952

This document consists of ___ pages, [redacted]

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By Authority of [illegible] 7127
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TECHNICAL MEMORANDUM REPORT

REMOVAL OF HYDROGEN FLUORIDE FROM AN AIR STREAM BY ADSORPTION IN A DOREX CHARCOAL FILTER

At the request of the Separations Section, a Dorex charcoal filter was evaluated with respect to its use for removal of low concentrations (0.2 mole per cent) of hydrogen fluoride gas from an air stream.

Experimental

The Dorex cannister contained approximately 550 grams of charcoal in a volume of 0.044 cubic feet. Its capacity for HF adsorption and working efficiency were determined by the method used previously (HW-23019). The capacity was measured for 0.2 volume per cent HF in air passing through the cannister at a velocity of ten cannister volumes per minute (0.43 CFM).

If the exhaust air from Hood 8, RG Line, 234-5 Building, were passed through one Dorex cannister, the air flow would be 194 cannister volumes per minute (250 ft/min through a 2 1/2 inch pipe). An attempt was made to simulate this flow rate, by taping 15/16 of a cannister, inside and out, for a measurement of the initial efficiency of adsorption. Use of a 0.5 CFM air flow gave an effective velocity of 180 cannister volumes per minute.

Results

With an air flow (0.2 mole per cent HF) of ten cannister volumes per minute, the charcoal in a Dorex cannister adsorbed 48 grams of hydrogen fluoride before the efficiency dropped markedly from the 96 - 98 per cent level (See accompanying figure).

At 180 cannister volumes per minute, the charcoal had an operating efficiency of 94 - 95 per cent.

Discussion

It appears that a charcoal cannister will have a satisfactory efficiency for use in removing HF from hood exhaust air. Where the possibility exists, however, that relatively large quantities of HF may be released periodically into the hoods, the capacity of a single cannister may be so limited as to require frequent changing.

Judging from the results reported by du Pont personnel at Oak Ridge (DPO 75, November 19, 1951), marble chips appear to be more suitable than charcoal for removal of HF from air streams. These results are quoted: using 4 - 8 mesh marble chips, greater than 99 per cent absorption was obtained up to the break-through point, at which point 85 per cent of the $CaCO_3$ had been used at break-through. No details of absorber dimensions, flow rates, or HF concentrations were mentioned.

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The accompanying table indicates the relative capacities of charcoal and $CaCO_3$. Assuming 80 per cent usage of the $CaCO_3$ before break-through, a bed of marble chips of the same volume as a Dorex charcoal cannister would absorb 1 kg of HF.

The products of the $CaCO_3$ - HF reaction (CaF_2, H_2O, CO_2) should cause no trouble, unless the CaF_2 powders, packs and plugs the cannister. This eventuality should be considered in designing an absorber for this operation.

Capacities of Charcoal and Marble Chips to Absorb HF

Absorbent	Density g/cc	Grams HF Absorbed	
		Per Gram Solid	Per Cm^3 Solid
Charcoal (Dorex Cannister)	0.22	0.083	0.02
Marble Chips	1.38	0.32*	0.44

*Assuming the reaction $2HF + CaCO_3 = CaF_2 + H_2O + CO_2$ and 80 per cent usage of $CaCO_3$ before break-through.

Figure I

Adsorption of HF by Dorex Charcoal Cannister