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MEMORANDUM

NOTE DE SERVICE

TO
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Mr. J. Scott, Mining Coordinator,
Abatement & Compliance Branch,
Place Vincent Massey, 13th Floor,
Hull, Quebec

FROM
DE

D. Cohen, Head,
Residue Management Unit,
Wastewater Technology Centre

SECURITY-CLASSIFICATION - DE SÉCURITÉ

OUR FILE-N/RÉFÉRENCE

Project 053

YOUR FILE-V/RÉFÉRENCE

DATE

12 July, 1977

SUBJECT
OBJET

GIANT YELLOWKNIFE SLUDGE DEWATERING TESTS

Dr. H. Erkkü (WTC coordinator of the DPAT GYK project) has requested that I forward to you directly the results of the bench scale sludge dewatering tests conducted by WTC Residue Management Unit staff.

Obviously if either the vacuum filtration or pressure filtration options were to be pursued further, pilot scale testing for optimization of filter cloths selection, polymer dosages, etc., would be required.

If further work in this area is indicated, please contact me at your earliest convenience.

D. B. Cohen, Head,
Residue Management Unit,
Wastewater Technology Centre

DBC/md

Attach/memo HC

cc: J. Schmidt
N. Schmidtke
H. Erkkü
H. Campbell



D.B. Cohen, Head
Residue Management Unit
Wastewater Technology Centre

H. Campbell
Residue Management Unit
Wastewater Technology Centre

SECURITY-CLASSIFICATION - DE SÉCURITÉ
OUR FILE--N/RÉFÉRENCE 053 107/24
YOUR FILE--V/RÉFÉRENCE
DATE July 12, 1977

SUBJECT
OBJET

SLUDGE DEWATERING TESTS - GIANT YELLOWKNIFE MINES

The two week test program on the carbon plant barren sludge (CPB) and the carbon plant barren plus lime (CPB + LIME) has been completed and the results summarized as follows:

1. Sludge Characterization

The results of the sludge characterization test are presented in Table 1. The values for capillary suction time (CST) and specific resistance indicate that either sludge will dewater very easily. Comparable values for a digested municipal sludge without conditioning would be a CST of 300 seconds and a specific resistance of 25×10^{13} m/kg. The low value for the coefficient of compressibility indicates that the material is nearly incompressible (Coefficient of compressibility for sand = 0) and the filtration rate will be directly proportional to the pressure.

2. Cyanide and Heavy Metals Analysis

Samples of both samples (total and filtered) have been submitted to the Analytical Services for analysis of cyanide, arsenic, iron, copper, zinc, nickel and calcium. Results will be forwarded when available.

3. Sludge Dewatering Tests

Results for the gravity thickening, bench centrifuge, leaf filter and bench filter press are shown in Table 2.

(a) Gravity Settling

Gravity settling tests were done in a 1 liter graduated cylinder. Twenty-four hours were required to obtain a reasonable volume reduction (30%). Based on visual observation gravity thickening would not be recommended because of the difficulties expected in removing the compacted sludge from the thickener.

(b) Bench Centrifuge

All bench centrifuge tests consisted of spinning a 50 ml sample on a lab centrifuge for 2 min. at 3500 rpm. In test 'A' the centrate was decanted and solids analysis done on both the decanted centrate and the remaining cake. In test 'B' the cake was scrolled out of the tube using a wood auger bit and a 5 ml

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sample pipetted immediately from the liquid remaining. The scrolled centrate refers to this 5 ml sample, while the scrolled cake refers to that portion of the cake removed by the auger. Centrifugation would not be recommended for the following reasons:

1. Although not evaluated it is probable that the sludge would be extremely abrasive.
2. The torque requirements for a scroll conveyor to remove the compacted sludge would be excessive.

(c) Filter Leaf

(KOMLINE-SANDERSON)

A stainless steel coil filter leaf test kit was used for all tests. Both materials filtered easily with good cake discharge characteristics. No cake drop off was observed even at the lowest cycle time. The relationship between yield and cycle time is shown in Figure 1. The yields obtained were in the order of 10 times those normally obtained with municipal sludges. The solids in the filtrate were extremely high, but it is probable that they could be significantly reduced by the use of either a different filter cloth or by polymer addition. Vacuum filtration under the conditions tested would reduce the volume of sludge for ultimate disposal to approximately one-half the original volume. Based on a conservative filter loading rate of $200 \text{ kg/m}^2\text{-h}$ approximately 10 m^2 (100 ft^2) of surface area would be required to filter 6000 lpgd in an 8-hour period.

(d) Bench Filter Press

All tests used 1 liter of sludge in the bench press. Both sludges filtered rapidly (maximum = 36 minutes) and the cakes discharged cleanly from the filter cloth. Filter pressure did not significantly affect cake solids but did affect filtration rate (Figure 2). An increase from 50 to 150 psi cut the pressing time in half. The filtrate solids were very low (200 mg/l or less) after the cake had formed on the filter media. The volume of filtrate with high solids at the beginning of the test accounted for less than 20% of the total volume of filtrate. The cake solids achieved gave a volume reduction of approximately 50%. It is expected that cake solids from a pilot or full-scale press (two sided filtration) would be higher. The cake solids achieved with a base metal mine sludge increased from an average of 31% on the bench press to an average of 41% on the pilot plant. Since pressing times can not be accurately predicted from bench tests, it is not possible to estimate the full-scale requirements for a filter press installation.

(e) Comparison of CPB and CPB + LIME

All filtration measurements indicated that the CPB + LIME filtered more easily than the CPB. The difference was not significant considering the ease with which either filtered. Suspended solids in

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the liquid fraction (filtrate or centrate) were generally lower for the CPB + LIME but again not significantly. The higher cake solids achieved with the CPB in all tests was attributed to the higher feed solids concentration.

4. Conclusions

- (a) Gravity thickening and centrifugation would not be recommended due to anticipated sludge removal problems.
- (b) Vacuum filtration or pressure filtration would be recommended as alternative methods because either would produce a higher concentrated cake which could be handled as a solid material. Additional experimental work would be required to reduce the level of suspended solids in the filtrate from the vacuum filter.

H. W. Campbell

H.W. Campbell

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TABLE 1. SLUDGE CHARACTERIZATION

PARAMETER	CPO	CPR + LIME
pH	7.6	10.1
TOTAL SOLIDS %	42.4	34.7
USP. SOLIDS g/l	575.5	441.2
DISSOLVED SOLIDS %	1.6	1.0
LABILE SOLIDS %	1.68	0.62
SLURRY DENSITY g/cm ³	1.4107	1.3087
RY SOLIDS DENSITY g/cm ³	3.22	3.17
APILLARY SUCTION TIME (SEC)	58.5	30.8
PEDIFIC RESISTANCE m/kg)		
8" Hg	0.0137×10^{13}	0.0095×10^{13}
15" Hg	0.0169×10^{13}	0.0134×10^{13}
22" Hg	0.0180×10^{13}	0.0166×10^{13}
25" Hg	0.0236×10^{13}	0.0153×10^{13}
EFFICIENT OF COMPRESSIBILITY	0.0145	0.0149

TABLE 2 .. BENCH DEWATERING TESTS

PARAMETER	CPB	CPB+LIME
<u>GRAVITY THICKENING</u>		
30 min. (m/l#)	995	990
24 hr. (m/l#)	630	700
CALCULATED AVERAGE SOLIDS ONCN AFTER 24 hr. (%)	57.5	45.0
VOLUME REDUCTION AFTER 24 hr. (%)	37	30
<u>BENCH CENTRIFUGE</u>		
TEST "A" - CAKE SOLIDS (%)	66.2	60.4
" " - CENTRATE S.S. (g/l)	0.54	0.30
TEST "B" - SCROLLED CAKE (%)	61.5	53.5
" " - SCROLLED CENTRATE (g/l)	75.4	99.9
<u>BAF FILTER</u>		
FILTRATE S.S. (g/l)		
CYCLE TIME = 1.0 min	262.93	131.6
" " = 3.0 "	277.80	91.1
" " = 5.0 "	264.40	70.2
CAKE SOLIDS (%)		
CYCLE TIME = 1.0 min	66.9	61.0
" " = 3.0 "	67.4	61.5
" " = 5.0 "	67.3	61.9
FILTER YIELD (kg/m ² -h)		
CYCLE TIME = 1.0 min	338	378
" " = 3.0 "	212	235
" " = 5.0 "	168	181

TABLE 2 (CONT). BENCH DEWATERING TESTS

PARAMETER	CPB	CPB + LIME
<u>FILTER PRESS</u>		
PRESS TIME (min)		
(TO BREAKTHROUGH) 50 psi	36.2	NOT RECORDED
100 psi	21.2	12.9
150 psi	15.8	8.8
FILTRATE VOL (mls)		
50 psi	444	448
100 psi	458	490
150 psi	459	504
FILTRATE S.S. (mg/l)		
) FIRST 100 mls 50 psi	60,100	50,900
100 psi	80,500	NOT RECORDED
150 psi	137,400	89,200
REMAINDER 50 psi	218	50
100 psi	199	NOT RECORDED (~5)
150 psi	169	NOT RECORDED (~5)
CARE SOLIDS (%)		
50 psi	68.3	58.8
100 psi	69.7	61.5
150 psi	69.8	62.5

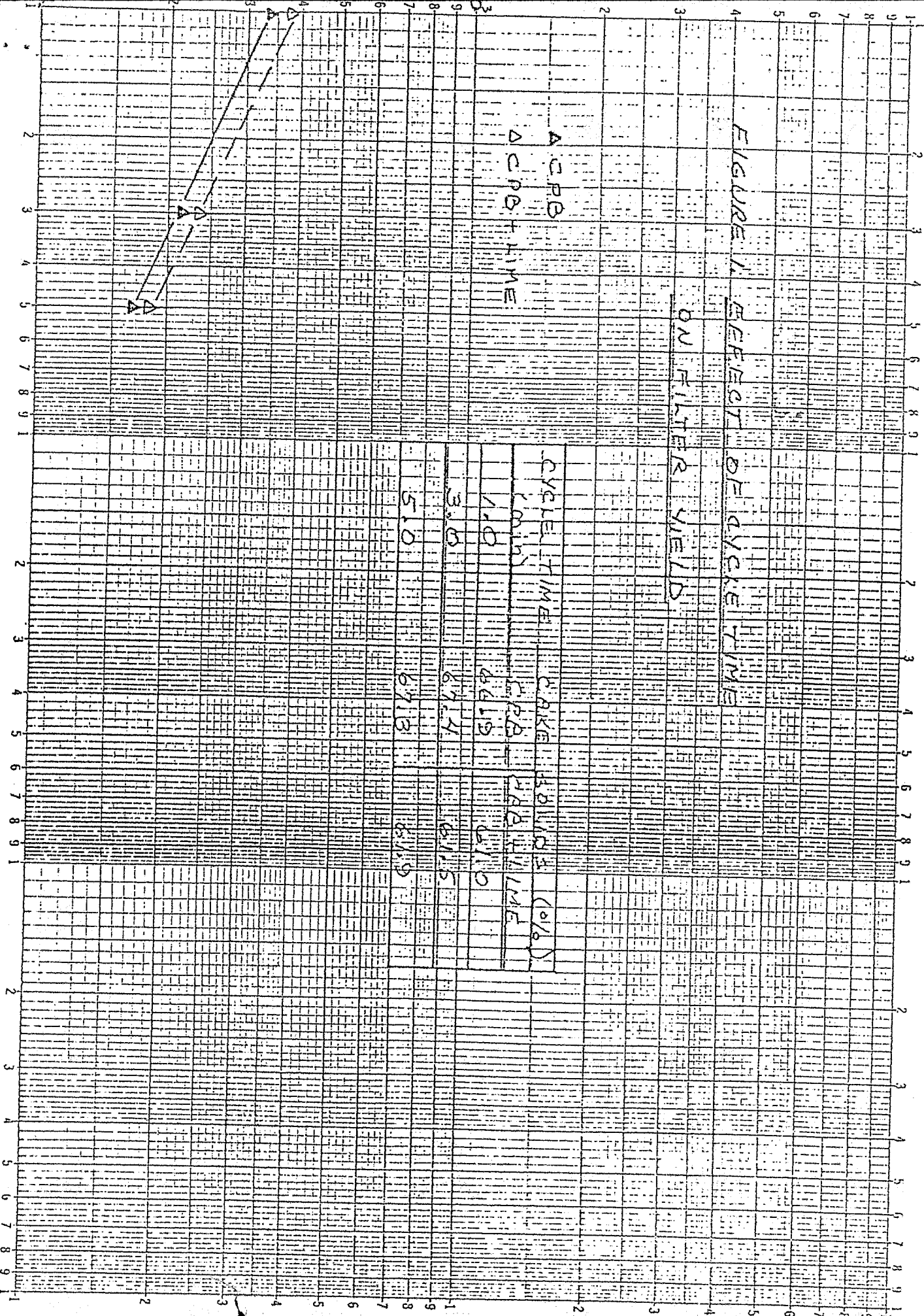
FIGURE 1. EFFECT OF CYCLE TIME

ON FILTER YIELD

Δ CFB
Δ CFB + TIME

CYCLE TIME (min)	CFB	CFB + TIME
1.0	66.15	66.15
3.0	67.4	67.5
5.0	67.13	67.13

CYCLE TIME (min)



Pressure (psi)	Cake Solids (%)	Coat + Lime
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50	68.3	58.8
100	69.7	61.5
150	69.8	62.5

EFFECT OF PRESSURE
ON FILTRATION RATE

