AN ASSESSMENT
OF
ODOUR CONTROL CHEMICALS
FOR USE IN
MARINE HOLDING TANKS AND TOILETS

Research Contract and Liaison Officer

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Project #1233

March 29,1974

ABSTRACT

Pollutech Pollution Advisory Services Limited was retained to assess the relative ability of odour chemicals to prevent the emission of objectionable sewage odours from marine holding tanks and recirculating toilets. A comprehensive inventory of nineteen commercially available preparations was prepared, listing manufacturers and suppliers, chemical constituents, dosage specifications, and cost information.

Sixteen of these formulations were evaluated in terms of their ability to control odours from two different sewage samples over a period of two weeks. It was found that $M^{C}1000$, was superior to all other products in this respect. Inca Gold, Sani Majik, Aqua-Kem and Monochem T-5 were somewhat less effective but exhibited better properties in terms of safety, handling, and convenience.

The anticipated impact of four of the odour control chemicals on a biological treatment unit was assessed by feeding an activated sludge culture with sewage containing selected dosages of these compounds. All of the products adversely affected the biological sludge although the effect of the zinc-based formulation was much more evident.

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Section 1. INTRODUCTION

Increased leisure time has led to a vastly expanded market for all facets of the recreational industry. Vacationers are spending extended periods of time isolated from conventional facilities aboard both commercial and pleasure boats and other recreational vehicles, equipped with portable or recirculating toilets, or sewage holding tanks. Without the addition of some controlling agent, storage of organic waste material would result in the production of various anaerobic odours due to microbial activity.

Numerous products are marketed for application in such systems for odour control. In general, these formulations contain an active disinfectant, normally in conjunction with a perfume to mask residual odours and a tracer dye to indicate spills from the sewage holding system.

Pollutech Pollution Advisory Services Limited was retained by Environment Canada and the Department of Supply and Services to carry out an intensive comparative evaluation of odour control chemicals as part of a detailed investigation of marine holding tanks. This report summarizes the findings of our study.

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Section 2. PROGRAM OBJECTIVES

The overall aim of the program was to prepare a detailed inventory of commercially available odour control chemicals and to assess the efficiency of these products for controlling odours from marine holding tanks. The anticipated effect of discharging the contents of such systems to conventional biological waste treatment facilities was evaluated using laboratory activated sludge simulators, shock-loaded with sewages containing pre-selected chemical additives at various concentrations.

The project was carried out in three distinct phases as follows:

Phase I Inventory of Products

Phase II Assessment of Odour Control Efficiency

Phase III Effect of Chemicals on Biological Treatment Systems

The procedures and results of each phase of the study will be dealt with separately in the following sections.

Section 3. PHASE I: INVENTORY OF PRODUCTS

A survey was carried out with the objective of compiling an inventory of commercially available odour control chemicals along with detailed information as to chemical constituents, recommended dosages and relative cost of individual products.

3.1 Procedure

In order to obtain preliminary information regarding suppliers and brand names of relevant products, reference was made to the following sources:

(i) Scott's Industrial Index, which provided the names of all chemical manufacturers and wholesalers in the immediate area who might be involved in the field of odour control chemicals;

(ii) marine suppliers, marinas, mobile trailer agencies and portable toilet manufacturers; and

(iii) The Ontario Ministry of the Environment, who kindly made available to us the names of products which had been submitted for their approval since March, 1965.

From this initial search, 59 organizations were contacted by telephone regarding the intent of this investigation. Subsequently, 33 letters requesting

technical information and a test sample for evaluation were forwarded to those groups which had confirmed their involvement in this area. This solicitation resulted in a total of 26 product names, of which 24 samples were obtained for further assessment. Five of the products received for testing did not appear to be applicable for the purpose of this investigation.

3.2 Results

The product inventory (Table 1), summarizes the information obtained for 19 odour control chemicals. This listing includes 17 products which are specifically manufactured for application in static and recirculating toilets and holding tank systems along with two other products, a deodorizer spray used around waste treatment facilities and a hospital disinfectant. These products were felt to have potential within the scope of this program. The product names listed in this inventory are, in most cases, unique; however, some formulations, such as Mobile Toilet Deodorant and C-0061, have been marketed under different names for other suppliers.

The applications of these products as prescribed by the suppliers are detailed in Table 1. The majority of the chemicals serve as both disinfectants and deodorizers while some are also listed as cleaning agents.

Technical data regarding the constituents of these chemicals are also summarized in Table 1. Much of this information was difficult to obtain as the majority of the products are marketed for American manufacturers and the information had to be solicited from the parent firm in the United States. Also, many groups felt that this was

proprietary information and were reluctant to release it.

Of the 19 applicable products, 9 contain formaldehyde as the active ingredient and 3 contain zinc sulphate. Both G. H. Woods' products are a mixture of these two chemicals. Quaternary ammonium compounds are the basis of two other formulations. Of the remaining chemicals, one is based on a steroid saponin compound while another contains a mixture of benzyl ammonium chloride. The chemical constituents of the outstanding product were not disclosed.

All of the chemicals except Consan 20, Freshette and Micro-Aid contain a perfume to mask any residual sewage odour. Many of the products also contain tracer dyes but little information was made available with regard to type or concentration.

The information regarding recommended dosage had to be evaluated on a comparative basis; therefore, the suppliers were requested to estimate the dosing requirements in terms of the weight of chemical required to neutralize a specific volume of waste material. From this data, the dosages and relative cost per dosage were calculated and given in the inventory. The cost index is derived from Canadian retail cost information supplied by the distributors as of December 31, 1973.

Section 4. PHASE II: EFFICIENCY OF ODOUR CONTROL CHEMICALS

The odour control chemical must be capable of preventing the production of malodorous anaerobic gases and removing residual sewage odours over an extended period of time. The available products were therefore evaluated to determine, under various conditions, their effectiveness in sewage holding tanks applications.

4.1 Procedure

Ten gallons of domestic raw sewage were obtained from a local source and divided into two equal parent samples. Urine was added to the second aliquot in order to evaluate the effectiveness of the chemicals under two conditions, high and low urine:faeces ratios. The high urine sewage sample was intended to represent conditions encountered on board boats used primarily for daysailing where there is usually a higher proportion of urine than faeces in the waste. The parent samples were allowed to stand for five days to attain anaerobic conditions.

Sixteen of the nineteen products listed in Table 1 were selected for the experimental evaluation. Craft-Chem, which is essentially the same formulation as C-0061, Destrine, which has limited applications, and Headomatic Liquid, a product similar to Headomatic Powder, were eliminated from further testing. The chemicals evaluated in Phase II are listed in Table 2, along with the alphabetical coding used in the subsequent data presentation.

From each parent sewage, a sequence of 200-ml aliquots was placed in well-sealed bottles. The chemicals were added to these aliquots in concentrations of 10%, 50%, 100%, 150%,

200% and 300% of the recommended dosage. Untreated sewage and odour-free water samples were prepared for comparison of the relative intensity of the odour. A test panel of five people was pre-selected from non-smokers on the POLLUTECH staff on the basis of their ability to judge odour intensity. This panel evaluated the samples on four occasions as follows:

- four hours after preparation
- two days after preparation
- seven days after preparation
- fourteen days after preparation

Over the test period, the samples were maintained at ambient room temperature.

The panel quantitatively evaluated three distinct odours - sewage, perfume and chemical - from each sample on an integral scale of increasing odour intensity from 0 to 3. Sewage odour intensity was estimated relative to the untreated parent sample odour at the time of testing. Chemical and perfume odours were evaluated relative to the addition of that particular chemical at 300% of recommended dosage to odour-free water.

Threshold Odour Numbers (TON) were determined according to the procedures outlined by Standard Methods (1971) on the high urine sample after fourteen days of contact with three of the most effective odour control chemicals.

4.2 Results

The data in terms of relative rating with respect to sewage, chemical and perfume odour are presented in Tables 3 to 26. These tables indicate the average odour intensity as calculated from the odour ratings stated by the individual panel members.

As the basic criterion for evaluation of the chemicals is the ability to control sewage odour, only the sewage odour ratings are presented in histogram form. This graphical comparison of the efficiency of the products at the recommended dosage is given in Figures 1 to 8 for both parent samples at each time of testing.

Uninhibited microbial action over an extended period of time will result in the production of characteristic anaerobic gases. In order to evaluate the ability of the chemicals to prevent decomposition of the sewage the effect of time on the relative odour intensity is illustrated in Figures 9 to 24, for each individual product at the recommended dosage.

At this dosage, it was found that only Inca Gold (Code H), M^{C}1000 (J), Monochem T-5 (L) and Sani Majik (N) were completely effective in masking any residual sewage odour from the low urine content sewage over the entire test period. Of these, Inca Gold (H) and M^{C}1000 (J) contain formaldehyde while Monochem T-5 (L) is a heavy-metal formulation and Sani Majik (N) is based on a quaternary-ammonium compound.

Under the more severe conditions of a high urine content sewage, only M^{C}1000 (J) was found to be completely effective. Inca Gold (H), which is a crystalline product designed to release its active agents slowly into the waste, did not

completely control the odour until after more than two days of contact. Of the remaining formulations, only Aqua-Kem (A) and Sani Majik (N) were capable of maintaining the residual sewage odour below a relative rating of 0.5 over the entire test period.

As indicated by Figures 9 to 24, many of these products appeared to be most effective during the period between two and seven days of contact. Few of the chemicals investigated, however, were capable of maintaining their activity over the entire two week period.

While many of the chemicals were found to be successful for odour control at recommended or higher dosages, a secondary guideline for relative evaluation could be based on effectiveness at lower concentrations. The relative sewage odour intensity in the presence of each chemical at 10% and 50% of the recommended dosage is shown in Figures 25 to 32. Only results for four hours and fourteen days contact are illustrated to cover the entire duration of the test.

At the lowest chemical dosage investigated (10%), Aqua-Kem (A) and M^C1000 (J) were relatively successful in controlling odour from the low urine sample but none of the additives at this concentration were effective in preventing odour emission from the high urine sample. At 50% of the recommended dosage, several chemicals including Aqua-Kem (A) and M^C1000 (J) were successful on the low urine sewage but none of the formulations could completely control the sewage odour from the high urine sample at both sampling times.

The ability to control sewage odour is dependent on both microbial inhibition and odour masking. It was found that those chemicals which were most effective in

preventing objectionable sewage odours also had the highest relative ratings in terms of perfume and/or chemical smell, as shown in Tables 11 to 26.

The high urine sewage containing M^{C}1000 (J), Monochem T-5 (L) and Sani Majik (N) at the recommended dosage were evaluated for Threshold Odour Number after fourteen days of incubation. The chemical, M^{C}1000 (J) had a TON of 2260, as compared to the untreated sewage TON of 1000. However, Monochem T-5 (L) and Sani Majik (N) had TON's of 800 and 670, respectively. Although these data are hardly conclusive, it is possible that chemicals with high TON levels rely more on their odour masking ability, whereas chemicals with lower TON levels rely more on their odour-reducing properties.

From these results, it appears that M^{C}1000 (J) is most effective for the control of odours from portable toilets and sewage holding tanks. However, this chemical is presently available for industrial toilets and large holding tanks only and the relative cost is based on large volume sales. This product is not retailed in quantities suitable for individual dosages to small systems. These safety and handling considerations, represent a serious limitation for the use of this product in small pleasure craft.

The remaining formulations are packaged for ease of handling and safe application.

Four other chemicals can be classified as marginally less effective than M^{C}1000 (J). They are Aqua-Kem (A), Inca Gold (H), Monochem T-5 (L) and Sani Majik (N). Each basic class of chemical is represented in this group. Of these four products, Aqua-Kem (A) is more than twice as expensive per recommended dosage as the others. The remaining three products are competitively priced.

The cost of one recommended dosage of Aqua-Kem (A) per 8 gallons of waste is $1.70 as compared to a range of $0.53 to $0.75 for the remaining three chemicals.

Section 5. PHASE III: EFFECT OF ODOUR CONTROL CHEMICALS ON BIOLOGICAL TREATMENT SYSTEMS

The contents of sewage holding tanks and recirculating toilets cannot be disposed directly into the receiving waters; rather, the chemical-containing wastes are normally discharged to a municipal sewer to be treated in a local Water Pollution Control Plant. Therefore, the objective of Phase III of the program was to assess the effect of these wastes on the operation of a conventional activated sludge system.

5.1 Procedure

One product from each of the three basic chemical classes - formaldehyde, heavy metal (Zn) and quaternary ammonium compounds - was selected for evaluation on the basis of its ability to control the emission of odours from the sewage samples. The chemicals were added at concentrations of 1%, 10%, and 50% of the recommended dosage to settled sewage from Elizabeth Gardens Water Pollution Control Plant, Burlington. The resultant mixture was shock-loaded on activated sludge from the same plant at a food to microorganism mass ratio approximating that in the full-scale system. This range of chemical concentrations was expected to indicate the onset of the inhibitory effect as well as the point of obvious toxicity.

The impact of the odour control chemicals on the biological sludge was evaluated by comparing the rate of substrate removal, in terms of soluble organic carbon, in the presence of the additives with the activity of a control simulation unit under the same operating conditions. The effect of the chemicals on the pH of the system and the

oxygen uptake rate of the biomass was also evaluated.

Sewage from Elizabeth Gardens had been selected for this investigation due to its low industrial waste content. However, spring runoff resulted in extremely low soluble organic carbon concentrations; therefore, in order to meaningfully compare the sludge activity in terms of TOC removal, the organic carbon content of the sewage was artificially increased by the addition of 108 mg/l glycerol.

5.2 Results

Based on the preliminary results of Phase II, Inca Gold (formaldehyde), Corlon Chem-67 (heavy metal-based) and Sani Majik (quaternary ammonium compound) were selected for this phase of the investigation. The addition of 10% of the recommended dosage of Sani Majik to the aerated mixed liquor, however, resulted in excessive foam production and subsequent loss of all biological solids from the liquid phase. It was concluded that the presence of this chemical in the biological system would adversely affect the treatment plant regardless of its impact on the sludge activity. The alternate quaternary ammonium based compound, Freshette, was therefore substituted in the detailed biological evaluation.

Inca Gold, a solid formaldehyde-based formulation, is designed to dissolve slowly in the waste, releasing the active ingredient as required. Even after 6 hours of aeration, undissolved crystals were apparent in the sludge

at the higher chemical dosages. Therefore, the relative effect of this chemical on the sludge activity is more difficult to assess as any difference in TOC removal rate cannot be attributed solely to a change in the condition of the biomass. The rate of dissolution of the formaldehyde, as well as the rate of removal due to air-stripping, will also affect the results.

The results in terms of soluble organic carbon removal are illustrated in Figures 33, 34 and 35 for 1%, 10% and 50% of the recommended dosage respectively. At the lowest chemical concentration (Figure 33), Inca Gold and Freshette did not affect the study but there did appear to be some inhibition due to the presence of Corlon Chem-67, as indicated by the initial lag in organic carbon removal.

At 10% of the recommended dosage (Figure 34), the impact of the odour control chemicals is much more evident. The heavy metal based formulation appears to be toxic to the biological sludge. The ultimate increase in soluble organic carbon concentration is probably due to cell lysis. In the presence of Inca Gold, the final TOC concentration was significantly higher due to either sludge inhibition or dissolution of the solid additive. Freshette, at this concentration, did not significantly affect the sludge activity.

At the highest dosage investigated, 50% of the recommended (Figure 35), the quaternary ammonium compound, Freshette, was found to inhibit the activity of the biomass, as measured by TOC removal. Inca Gold was also found to adversely affect the system. Corlon Chem-67 was not evaluated at this dosage due to its obvious toxicity at the lower concentration.

The oxygen uptake rates of the sludges, as summarized in Table 27, confirm the toxicity of Corlon Chem-67. In the presence of the heavy metal based compound at 10% of the recommended dosage, the respiration rate decreased to only 25% of that of the control sludge. The other chemicals did not, however, significantly affect the rate of oxygen utilization. This verifies to some extent the premise that the increase in TOC concentrations in the presence of Inca Gold is at least partially due to dissolution of the chemical during treatment.

It was also noted, that the addition of any of these chemicals at only 10% of the recommended dosage affected the settleability of the sludge. There appeared to be a significant increase in the suspended solids content of the supernatant, which would be attributed to the presence of these chemicals.

As indicated by Table 28, any change in the sludge condition is not due to changes in the system pH caused by the chemicals. Corlon Chem-67, due to the presence of aluminum sulphate in this preparation, slightly decreased the system pH to 6.98 at a dosage of 10% of the recommended and Inca Gold increased the pH to 8.45 at 50% of the recommended dosage, but these values are within the acceptable range for biological treatment.

The presence of tracer dyes in Inca Gold and Corlon Chem-67 resulted in an intense blue coloration of the effluent at 10% of the recommended dosage and a slight discoloration as low as 1% of the recommended dosage. Discharge of a deeply coloured effluent can adversely affect the receiving streams, biologically as well as aesthetically. The formaldehyde compound also resulted in an objectionable chemical odour from

the aeration tank even at the lowest dosage investigated.

The Threshold Odour Number of the settled supernatant was evaluated for all of the laboratory simulators. Although these results were inconclusive, it appeared that the absolute odour of the secondary effluent would be increased by the presence of formaldehyde in the system, even at 10% of the recommended dosage. The other chemicals did not appear to affect the quality of the effluent in this respect.

Section 6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this investigation, the following inferences can be drawn:

- A comprehensive inventory of commercially available odour control chemicals revealed a wide selection of diverse products applicable for marine holding tanks and recirculating toilets.

- Of these products, M^C1000 was the most effective for controlling objectionable sewage odours under all conditions. Furthermore, it was the most economical of the five acceptable odour control chemicals found.

- M^C1000 successfully controlled odours on a low urine: faeces ratio sewage sample at only 50% of the recommended dosage.

- Presently M^C1000 is not marketed in convenient pre-packaged dosage quantities.

- Of the remaining formulations, at least one product from each basic class was found to perform adequately. They included Inca Gold (formaldehyde base), Sani Majik (quaternary ammonium base) and Monochem T-5 (zinc sulphate base). Aqua Chem (formaldehyde base) was equally effective for control of sewage odours but was not competitively-priced due to the high dosage required.

- All of these chemical formulations will have a deleterious effect on a biological treatment process if discharged in sufficient quantities. The treatment

process was most sensitive to the heavy metal compounds.

- Shock-loadings of these chemicals to a municipal waste treatment plant could adversely affect the settleability of the sludge. The presence of tracer dyes also results in a distinct discoloration of the treatment system effluent.

- All of the chemicals evaluated in this study contain highly toxic compounds and should be handled with appropriate caution.

TABLES

TABLE NO. 1

INVENTORY OF ODOUR CONTROL CHEMICALS

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
AQUA-KEM	Traco Mfg. Ltd., 1045 Nargrieve Rd., London, Ontario.	Thetford Corp., Box 1285, Ann Arbor, Mich. U.S.A.	Odour Control (Portable toilets and holding tanks)	Formaldehyde 35% Perfume 2% Blue Dye 2%	8 oz.	$1.70
C-0061	C.H. Woods, Queen Elizabeth Way Box 34, Toronto, Ontario.	G. H. Woods, Queen Elizabeth Way Box 34, Toronto, Ontario.	Odour Control & Disinfection (Portable and re-circulating toilets and holding tanks)	Formaldehyde 9% Zinc Sulphate 25% Perfume 0.12% Tracer Dye 0.3%	4 oz.	$0.26
CONSAN 20 (ODOR GUARD)	Consan of Canada, 507 King St.E., Toronto, Ontario.	Consan of Canada, 507 King St.E., Toronto, Ontario.	Odour Control & Disinfection (Portable toilets and holding tanks. Also general sanitation.)	Mixture of dimethyl benzyl ammonium chlorides and ethyl benzyl ammonium chlorides	4 oz.	$0.52

TABLE NO. 1 CONT'D

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
CORLON CHEM-67	Monogram Sanitation Products of Canada, 3332 Mainway, Burlington, Ontario	Monogram Industries Inc. 1165 E.230th St., Carson, California, U.S.A. 90745	Odour Control (prolonged)(in chemical toilets and holding tanks)	Zinc Sulphate 30% Aluminum Sulphate 60% Perfume 3% Blue Dye 2%	2 oz.	$0.45
CRAFT-CHEM	North Air, Box 881, Oshawa, Ontario.	(Was produced by G.H. Woods for Canadian Gisholt Plastics Ltd., 7 Plastics Ave., Toronto, Ontario.)	Odour Control (in recirculating and automatic flush toilets)	Formaldehyde	4.7 oz.	
DESTRINE	Hunter Enterprises Orillia, Ontario.	Hunter Enterprises Orillia, Ontario.	Odour Control (in Kemlet portable toilets) only	DCMX Undisclosed composition (Not Formaldehyde)	---	---

TABLE NO. 1 CONT'D

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
ELSAN BLUE	Lawrence & Newell, 142 Bentworth Ave., Toronto, Ontario.	Elsan Ltd., England.	Odour Control, Disinfection, Cleaning	Formaldeyde 10%	5 oz.	$0.26
FRESHETTE	Associated Chemical Co. of Canada Ltd., 40 Bartor Rd., Weston, Ontario.	Associated Chemical Co.of Canada Ltd., 40 Bartor Rd., Weston, Ontario.	Odour Control (in marine holding tanks)	Quarternary Ammonium Compound 50%	0.205 oz. (4 tablets)	$0.24
HEADOMATIC POWDER	Alex Milne Assoc., 1032 Henley Rd., Mississauga,Ont.	Alex Milne Assoc., 1032 Henley Rd., Mississauga,Ont.	Odour Control (in static and recirculating toilets.)	Formaldehyde U.S.P. Perfume	4 oz.	$1.98
HEADOMATIC LIQUID	Alex Milne Assoc., 1032 Henley Rd., Mississauga,Ont.	Alex Milne Assoc., 1032 Henley Rd., Mississauga,Ont.	Odour Control (in static and recirculating) toilets.	Formaldehyde U.S.P. Perfume	---	---

TABLE NO. 1 CONT'D

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
INCA GOLD	Greg Lund Products Ltd., 521 N.Service Rd.E., Oakville, Ont.	Inca-One Corp., 5541 W.Washington Blvd., Los. Angeles, California 90016	Odour Control (prolonged)(in all chemical toilets & holding tanks)	Formaldehyde Perfume - pine oil derivative	2 oz.	$0.64
KN-48	Greg Lund Products Ltd., 521 N.Service Rd.E., Oakville, Ont.	Zevel Corp., P.O. Box 112, Lamirada,Calif. 90638	Odour Control (in portable toilets and holding tanks.)	Zinc Sulphate 90% Perfume	2 oz.	$0.45
MC1000	Monogram Sanitation Products of Canada, 3332 Mainway, Burlington, Ontario	Monogram Industries Inc. 1165 E.230th St., Carson, California, U.S.A. 90745	Odour Control (in "Jet-o-Matic" industrial toilets and large holding tanks.)	Formaldehyde 28.1% Perfumes- Persica 3.0% Citron 3.0% Dye-Alphazurine Blue 0.7%	8.46	$0.66

TABLE NO. 1 CONT'D

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
MICRO-AID	Stewart Oxygen Services (Cda) Ltd., 491 Brimley, Toronto, Ontario.	Distributors Processing Inc., Porterville, California.U.S.A.	Odour Control (in septic tank and waste treatment areas.)	Steroid Saponins (10%)	Untried	---
MOBILE TOILET DEODORANT	G.H. Woods, Queen Elizabeth Way Box 34, Toronto, Ontario.	G.H. Woods, Queen Elizabeth Way Box 34, Toronto, Ontario.	Odour Control and Disinfection (in portable and recirculating toilets and holding tanks.)	Formaldehyde 10% Zinc Sulphate 7% Perfume 0.2% Tracer Dye 0.4%	4 oz.	$0.22
MONOCHEM T-5	Monogram Sanitation Products of Canada, 3332 Mainway, Burlington, Ontario	Monogram Industries Inc., 1165 E.230th St., Carson, California, U.S.A. 90745	Odour Control (in monomatic toilets and all other mobile sanitation equipment)	Zinc Sulphate 30% Perfume	2 oz.	$0.75

TABLE NO. 1 CONT'D

PRODUCT NAME	SUPPLIER	MANUFACTURER	PRESCRIBED FUNCTION	ACTIVE INGREDIENTS (% in W/W)	RECOMMENDED DOSE PER 8 GL. OF WASTE	RELATIVE COST PER REC. DOSE
PTC	Monogram Sanitation Products of Canada, 3332 Mainway, Burlington, Ontario	Monogram Industries Inc., 1165 E.230th St., Carson, California, U.S.A. 90745	Odour Control (prolonged)(in all portable toilets & holding tanks.)	Formaldehyde	2 oz.	$0.37
SANI MAJIK	Greg Lund Products Ltd., 521 N.Service Rd.E. Oakville, Ontario.	Mansfield Sanitary Inc., 150 First St., Perrysville,Ohio. U.S.A. 44864	Odour Control (in all portable toilets and holding tanks.)	Quaternary Ammonium Compound Perfume	4 oz.	$0.53
SANITOR FLUID	West Chemical Products Ltd., 325 Dalesford Rd., Toronto, Ontario.	West Chemical Products Ltd., 5623 Casgrain, Montreal, Quebec.	Odour Control and Cleaning Agent (for industrial purposes only - aircraft, buses, railways, construction)	Formaldehyde 2%	8 oz.	$0.15

TABLE 2. ALPHABETICAL CODING OF ODOUR CONTROL CHEMICALS

CODE	PRODUCT NAME
A	Aqua-Kem
B	C-0061
C	Consan 20
D	Corlon Chem-67
E	Elsan Blue
F	Freshette
G	Headomatic Powder
H	Inca Gold
I	Kn-48
J	$M^{C}1000$
K	Mobile Toilet Deodorant
L	Monochem T-5
M	PTC
N	Sani Majik
O	Sanitor Fluid
P	Micro-Aid

TABLE 3. EVALUATION OF RELATIVE SEWAGE ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	2.0	2.0	1.5	2.0	3.0	2.0	1.5	2.5	0.0	2.0	1.0	1.0	1.5	1.0	2.0
50	0.0	1.0	2.0	1.0	1.0	2.5	1.0	0.5	1.5	0.0	1.0	0.5	0.5	0.5	0.5	2.0
100	0.0	0.5	1.0	0.5	0.5	2.0	1.0	0.0	1.0	0.0	0.5	0.0	0.5	0.0	0.0	2.0
150	0.0	0.5	1.0	0.0	0.0	1.5	1.0	0.0	1.0	0.0	0.5	0.0	0.5	0.0	0.0	1.5
200	0.0	0.0	0.5	0.0	0.0	1.5	1.0	0.0	1.0	0.0	0.5	0.0	0.5	0.0	0.0	1.0
300	0.0	0.0	0.5	0.0	0.0	1.0	0.5	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.5

TABLE 4. EVALUATION OF RELATIVE SEWAGE ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	2.0	2.5	1.0	2.0	2.0	1.5	2.0	1.0	0.0	1.5	1.0	1.5	2.0	1.5	2.0
50	0.5	1.0	1.5	1.0	1.0	2.0	1.0	0.0	1.0	0.0	0.5	0.0	0.0	0.0	1.5	1.5
100	0.5	0.5	1.0	0.0	1.0	2.0	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5
150	0.5	0.0	1.0	0.0	1.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
200	0.0	0.0	0.5	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
300	0.0	0.0	0.5	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5

TABLE 5. EVALUATION OF RELATIVE SEWAGE ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	1.0	1.5	0.5	1.0	1.0	0.5	1.5	1.0	0.0	0.5	0.5	0.5	0.5	0.0	0.5
50	0.5	0.5	0.5	0.0	0.5	1.0	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.5	0.5
100	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0
150	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
200	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
300	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0

TABLE 6. EVALUATION OF RELATIVE SEWAGE ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	0.0	1.5	1.5	0.5	1.0	1.0	1.0	1.0	1.5	0.5	0.5	1.0	1.0	1.5	1.0	0.5
50	0.0	0.5	1.0	0.0	0.5	1.0	0.5	0.5	1.0	0.0	0.0	0.0	0.5	0.5	1.0	0.0
100	0.0	0.5	0.0	0.0	0.5	1.0	0.5	0.0	0.5	0.0	0.0	0.0	0.5	0.0	1.0	0.0
150	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
200	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
300	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0

TABLE 7. EVALUATION OF RELATIVE SEWAGE ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	2.5	2.0	3.0	2.5	3.0	3.0	3.0	2.5	2.5	1.5	2.5	2.0	2.5	2.0	2.0	2.5
50	2.0	2.0	3.0	2.0	2.0	2.5	2.0	2.0	2.5	1.0	2.0	1.5	2.0	1.0	1.0	2.5
100	0.5	1.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	0.0	1.5	0.5	2.0	0.5	1.0	2.0
150	0.0	1.0	2.0	1.0	1.5	1.5	1.5	0.5	2.0	0.0	1.0	0.0	1.0	0.0	0.5	1.5
200	0.0	0.5	2.0	0.0	1.5	2.0	1.5	0.5	1.5	0.0	1.0	0.0	1.0	0.0	0.0	1.0
300	0.0	0.0	1.5	0.0	1.0	1.5	1.0	0.0	1.0	0.0	1.0	0.0	0.5	0.0	0.0	1.0

TABLE 8. EVALUATION OF RELATIVE SEWAGE ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	2.5	2.5	2.5	2.0	3.0	3.0	2.5	2.5	3.0	1.5	2.5	2.5	3.0	2.5	2.0	2.5
50	1.0	1.5	2.5	1.5	2.0	2.5	2.0	0.5	2.5	0.0	1.5	1.0	2.0	1.0	1.0	2.5
100	0.5	1.0	2.0	1.0	1.0	2.0	1.5	0.0	2.0	0.0	1.0	0.5	1.0	0.0	0.5	2.0
150	0.5	0.5	2.0	0.0	1.0	2.0	1.0	0.0	1.5	0.0	0.5	0.0	1.0	0.0	0.0	2.0
200	0.5	0.0	1.0	0.0	0.5	2.0	1.0	0.0	1.0	0.0	0.0	0.0	0.5	0.0	0.0	1.5
300	0.0	0.0	1.0	0.0	0.0	1.5	0.5	0.0	1.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0

TABLE 9. EVALUATION OF RELATIVE SEWAGE ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	3.0	2.5	3.0	2.0	3.0	2.0	3.0	2.5	2.5	1.5	2.0	2.5	3.0	2.5	3.5	2.5
50	0.5	1.0	2.0	1.5	3.0	2.0	2.5	1.0	2.5	0.0	1.0	1.0	2.0	1.0	1.5	3.0
100	0.0	0.0	1.5	1.0	1.5	2.0	2.0	0.0	1.5	0.0	0.5	0.5	1.0	0.5	0.5	2.5
150	0.0	0.0	1.0	0.5	0.5	2.0	1.0	0.0	1.0	0.0	0.5	0.5	0.0	0.0	0.0	2.5
200	0.0	0.0	0.5	0.5	0.5	1.5	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	3.0
300	0.0	0.0	0.5	0.0	0.5	1.5	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	3.0

TABLE 10. EVALUATION OF RELATIVE SEWAGE ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	2.5	2.5	3.0	2.5	3.0	3.0	2.0	2.0	3.0	1.0	3.0	2.0	3.0	2.5	2.5	2.5
50	1.0	1.0	1.5	1.5	2.5	2,5	1.0	0.5	2.5	0.0	2.0	1.0	3.0	1.5	0.5	2.0
100	0.5	0.5	1.5	1.5	1.5	2.0	1.5	0.0	2.0	0.0	1.0	1.0	1.0	0.5	0.5	2.0
150	0.0	0.0	0.5	1.0	1.0	1.5	0.0	0.0	1.5	0.0	1.0	0.0	0.5	0.5	0.0	1.5
200	0.0	0.0	0.5	0.5	0.0	1.0	1.0	0.0	1.0	0.0	0.5	0.0	0.0	0.5	0.0	1.5
300	0.0	0.0	0.5	0.0	0.0	1.0	0.5	0.0	1.5	0.0	0.5	0.0	0.0	0.0	0.0	1.5

TABLE 11. EVALUATION OF RELATIVE CHEMICAL ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.5	0.0	0.0	0.5	0.0	0.5	0.0
50	0.5	0.5	0.0	1.0	1.0	0.0	1.0	1.0	0.5	0.5	1.0	1.0	1.0	1.0	0.5	0.0
100	1.0	0.5	0.5	1.0	1.0	0.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0	0.5	0.0
150	1.0	0.5	0.5	1.5	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0	0.5	0.5
200	1.0	1.0	0.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	1.5	2.0	1.0	1.0	0.5	0.5
300	1.0	1.0	1.0	1.5	2.0	1.0	1.0	1.5	1.0	1.0	1.5	2.0	1.0	1.0	0.5	0.5

TABLE 12. EVALUATION OF RELATIVE CHEMICAL ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.0	0.5	0.0	0.5	0.0	0.0	0.5	0.0	0.5	0.5	0.0	0.5	0.0	0.5	0.5	0.0
50	1.0	1.0	0.5	1.0	0.5	0.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	0.5	1.0	0.5
100	1.0	2.0	0.5	1.0	0.5	0.5	1.0	1.0	1.0	0.5	1.0	1.5	1.0	1.0	1.0	1.0
150	1.5	2.0	0.5	1.5	1.0	0.5	1.0	1.0	1.0	1.0	1.5	2.0	1.5	1.0	1.0	1.0
200	2.0	2.0	0.5	2.0	1.0	0.5	1.5	1.5	1.0	1.0	1.5	2.0	1.5	1.0	1.5	1.0
300	2.0	2.5	0.5	2.0	1.0	1.0	1.5	2.0	1.5	1.0	2.0	2.0	2.0	1.0	1.5	1.0

TABLE 13. EVALUATION OF RELATIVE CHEMICAL ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	1.0	0.5	0.5	0.5
50	1.5	1.5	0.5	0.5	0.5	0.5	1.0	1.0	0.5	1.0	1.0	0.5	1.0	0.5	0.5	0.5
100	1.5	2.0	0.5	1.0	1.0	0.5	1.0	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0	1.0
150	1.5	2.0	0.5	1.0	1.5	0.5	1.0	1.5	1.0	1.5	1.0	0.5	1.5	1.0	1.0	1.0
200	1.5	2.0	0.5	2.0	1.5	0.5	1.0	1.5	1.0	1.5	1.0	0.5	1.5	1.0	1.0	1.0
300	2.0	2.5	1.0	2.5	1.5	1.0	1.0	2.0	1.5	2.0	1.5	1.0	2.0	1.0	1.5	1.0

TABLE 14. EVALUATION OF RELATIVE CHEMICAL ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	0.5	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
50	1.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5
100	1.5	1.5	0.5	0.5	0.5	1.0	0.5	1.0	0.5	0.5	1.0	1.0	0.5	0.5	1.0	0.5
150	2.0	1.5	0.5	1.0	0.5	1.0	1.0	1.5	0.5	0.5	1.0	1.0	1.0	0.5	1.0	1.0
200	2.0	2.0	0.5	1.5	1.0	1.0	1.0	1.5	0.5	1.0	1.0	1.5	1.5	1.0	1.0	1.5
300	3.0	2.5	1.0	1.5	1.0	1.0	1.0	1.5	1.0	1.0	1.5	1.5	1.5	1.0	1.5	1.5

TABLE 15. EVALUATION OF RELATIVE CHEMICAL ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0
50	0.5	1.0	0.5	1.0	0.0	0.5	0.5	1.0	0.0	1.0	0.5	0.5	0.5	0.5	0.0	0.5
100	1.0	1.0	0.5	1.0	0.5	0.5	0.5	1.5	0.5	1.0	0.5	0.5	1.0	1.0	0.5	0.5
150	1.0	1.0	0.5	1.5	1.0	0.5	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5
200	1.0	1.0	0.5	2.0	1.0	0.5	1.0	2.0	1.0	1.0	1.0	1.5	1.5	1.5	0.5	0.5
300	1.5	1.5	0.5	2.0	1.5	0.5	1.5	2.0	1.0	1.0	1.5	1.5	2.0	2.0	0.5	0.5

TABLE 16. EVALUATION OF RELATIVE CHEMICAL ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.5	0.0
50	1.0	1.0	0.5	1.5	1.0	0.5	0.5	1.0	0.0	1.0	1.0	1.5	1.0	1.0	1.0	0.0
100	1.5	1.0	1.0	1.5	1.0	1.0	1.0	1.5	0.5	1.0	1.5	1.5	1.0	1.0	1.0	0.5
150	2.0	2.0	1.0	1.5	1.5	1.0	1.5	1.5	1.0	1.5	1.5	2.0	1.0	1.0	1.0	1.0
200	2.0	2.5	1.0	1.5	2.0	1.0	1.5	2.0	1.0	1.5	2.0	2.0	2.0	1.0	1.0	1.0
300	2.0	2.5	1.0	2.0	2.0	1.0	1.5	2.0	1.5	1.5	2.0	2.0	2.0	1.0	1.5	1.0

TABLE 17. EVALUATION OF RELATIVE CHEMICAL ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	1.0	0.5	1.0	0.0	0.5	0.0	1.0	0.5	0.5	0.5	0.5	0.5	1.0	0.0	0.0
50	1.5	1.5	1.0	1.0	0.5	0.5	0.5	1.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
100	1.5	2.0	1.0	1.5	1.0	1.0	1.0	2.0	1.0	1.0	1.5	1.5	1.5	1.0	1.0	1.0
150	2.0	2.0	1.0	1.5	1.5	1.0	1.0	2.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.0
200	2.5	2.0	1.5	1.5	1.5	1.0	1.5	2.0	1.0	1.0	2.0	1.5	1.5	1.5	1.5	1.5
300	2.5	3.0	1.5	2.0	1.5	1.0	1.5	2.5	2.0	1.5	2.0	2.0	2.0	1.5	1.5	1.5

TABLE 18. EVALUATION OF RELATIVE CHEMICAL ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	0.5	0.5	1.0	0.5	0.5	1.0	1.0	0.0	1.5	0.5	1.0	0.5	1.0	0.5	0.5
50	1.5	1.5	1.0	1.5	0.5	0.5	1.0	1.0	0.5	1.5	0.5	1.0	1.0	1.5	0.5	1.0
100	1.5	2.0	1.0	1.5	1.0	1.0	1.5	1.5	1.0	2.0	1.0	1.5	1.0	1.5	0.5	1.0
150	2.5	2.0	1.5	1.5	1.0	1.0	1.5	1.5	1.0	2.0	1.0	2.0	1.5	1.5	0.5	1.0
200	2.5	2.5	1.5	2.0	1.5	1.0	1.5	2.0	1.0	2.0	2.0	2.0	2.0	1.5	1.0	1.5
300	3.0	3.0	1.5	2.5	1.5	1.5	2.0	2.0	1.5	2.5	2.5	2.0	2.5	1.5	1.0	1.5

TABLE 19. EVALUATION OF RELATIVE PERFUME ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.5	1.0	0.0
50	2.0	1.0	0.0	1.0	1.0	0.0	0.0	1.0	0.5	2.0	0.5	1.5	0.5	1.5	1.5	0.0
100	2.0	1.0	0.0	1.5	1.5	0.0	0.0	1.5	1.0	2.0	0.5	1.5	0.5	2.0	2.0	0.0
150	2.0	2.0	0.0	1.5	1.5	0.0	0.0	2.0	1.0	2.0	0.5	2.0	1.0	2.0	2.0	0.0
200	2.5	2.0	0.0	2.0	1.5	0.0	0.0	2.0	1.0	2.0	0.5	2.5	1.0	2.5	2.5	0.0
300	2.5	2.5	0.0	2.0	2.0	0.0	0.0	2.0	1.0	2.5	0.5	3.0	2.0	2.5	2.5	0.0

TABLE 20. EVALUATION OF RELATIVE PERFUME ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C	P
10	1.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0	0.0	0.5	0.0	0.0	1.0	0.0
50	1.0	1.0	0.0	0.5	1.0	0.0	0.5	1.5	0.5	2.0	0.5	1.0	1.0	1.5	1.0	0.0
100	2.0	1.5	0.0	1.0	1.0	0.0	0.5	2.0	0.5	2.0	0.5	1.5	1.0	1.5	1.5	0.0
150	2.0	1.5	0.0	1.0	1.5	0.0	0.5	2.0	0.5	2.0	1.0	1.5	1.0	1.5	1.5	0.0
200	2.0	2.0	0.0	1.5	2.0	0.0	1.0	2.0	0.5	2.0	1.0	1.5	1.5	2.0	1.5	0.0
300	2.0	2.0	0.0	2.0	3.0	0.0	1.0	2.5	1.0	2.5	1.5	2.5	2.0	2.5	2.0	0.0

TABLE 21. EVALUATION OF RELATIVE PERFUME ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	1.5	0.5	0.0	0.5	0.5	0.5	0.5	0.0	0.5	1.0	0.5	0.5	0.5	1.0	1.0	0.0
50	2.0	1.0	0.5	1.0	1.0	0.0	0.5	1.0	0.5	2.0	1.0	1.5	0.5	1.0	0.5	0.0
100	2.0	1.5	0.5	1.5	1.0	0.0	0.5	2.0	1.0	2.0	0.5	2.0	1.0	1.5	1.0	0.0
150	2.0	1.5	0.5	1.5	1.5	0.5	0.5	2.0	1.0	2.0	0.5	2.5	1.5	1.5	1.5	0.0
200	2.0	2.0	0.5	2.0	1.5	0.5	0.5	2.0	1.5	2.5	1.0	2.0	2.0	2.0	2.0	0.5
300	2.5	2.0	1.0	2.0	2.0	0.5	0.5	3.0	2.0	3.0	1.0	3.0	2.0	2.0	2.5	0.0

TABLE 22. EVALUATION OF RELATIVE PERFUME ODOUR

Low Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.5	0.0
50	0.5	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	2.0	1.0	1.5	0.0	1.0	0.5	0.0
100	1.0	0.5	0.0	1.5	1.0	0.5	0.0	1.5	1.0	2.5	1.0	2.0	1.0	1.0	0.5	0.0
150	1.0	0.5	0.5	1.5	1.0	0.5	0.5	2.0	1.0	2.5	1.0	2.0	1.0	1.5	1.0	0.0
200	0.5	1.0	1.0	2.0	1.5	0.5	0.0	1.5	1.5	2.5	1.0	2.5	1.5	2.5	2.0	0.0
300	1.0	1.0	0.5	2.0	1.5	0.5	0.5	2.0	1.5	3.0	1.5	2.5	2.0	2.0	2.5	0.0

TABLE 23. EVALUATION OF RELATIVE PERFUME ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 4 hours

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	0.5	0.5	0.0
50	1.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.5	1.0	0.0	1.0	1.0	0.0
100	1.5	0.5	0.0	0.5	0.5	0.0	0.0	0.5	0.0	2.0	0.5	1.5	0.5	2.0	1.0	0.0
150	1.0	1.0	0.0	1.0	1.0	0.0	0.0	1.0	0.0	2.0	0.5	2.0	0.5	2.0	2.0	0.0
200	2.0	1.0	0.0	1.0	1.0	0.0	0.0	1.0	0.5	2.5	1.0	2.5	1.0	2.0	2.0	0.0
300	2.5	2.0	0.0	1.0	1.0	0.0	0.0	2.5	0.5	2.5	1.0	3.0	0.0	2.0	2.0	0.0

TABLE 24. EVALUATION OF RELATIVE PERFUME ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 2 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.5	0.5	0.0
50	1.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.5	0.5	1.0	0.0	1.5	1.5	0.0
100	1.5	1.0	0.0	1.0	1.0	0.0	0.0	1.5	0.0	2.0	1.0	1.5	1.0	2.0	2.0	0.0
150	2.0	1.5	0.0	1.0	1.0	0.0	0.0	2.0	0.0	2.0	1.0	2.0	1.0	2.5	2.5	0.5
200	2.0	2.0	0.0	1.0	1.0	0.0	0.0	2.0	0.0	2.5	1.0	2.0	1.0	2.5	2.5	0.5
300	2.5	2.0	0.0	2.0	1.5	0.0	0.0	2.5	0.5	3.0	1.0	2.0	1.5	2.5	2.5	0.5

TABLE 25. EVALUATION OF RELATIVE PERFUME ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 7 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.5	0.0	1.5	0.5	0.5	0.0	0.5	0.0	0.0
50	1.5	1.0	0.0	0.5	0.0	0.0	0.0	2.0	0.0	2.0	0.5	1.0	0.5	1.0	1.0	0.0
100	2.0	1.5	0.0	1.0	0.5	0.0	0.5	2.0	0.5	2.5	1.5	2.0	1.0	1.5	2.0	0.0
150	2.0	1.5	0.0	1.5	1.5	0.0	0.5	2.0	1.0	2.5	2.0	2.0	1.0	2.5	2.0	0.0
200	2.5	2.0	0.5	1.5	2.0	0.0	1.0	2.0	1.0	3.0	2.0	2.0	1.5	2.5	2.0	0.0
300	3.0	2.5	0.5	1.5	2.0	0.5	1.0	3.0	1.5	3.0	2.0	3.0	1.5	2.5	2.0	0.0

TABLE 26. EVALUATION OF RELATIVE PERFUME ODOUR

High Urine Sewage Sample
Contact Time of Sewage and Chemical - 14 days

Percent of Recommended Dosage \ Chemical Code	Relative Odour Rating															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.5	0.0	0.0	0.5	0.5	0.0	0.5	1.5	0.0	1.5	1.0	1.5	0.0	0.5	1.0	0.0
100	1.0	0.5	0.0	1.0	1.0	0.0	0.5	1.5	0.5	2.0	1.0	2.0	1.0	1.5	1.5	0.0
150	1.5	1.0	0.0	0.5	1.5	0.0	1.0	2.0	0.5	1.5	1.0	2.5	1.5	2.0	1.5	0.0
200	1.5	1.0	0.5	0.5	2.0	0.0	0.5	2.0	0.5	2.5	1.5	2.0	2.0	2.0	2.0	0.0
300	1.5	1.5	0.5	1.5	2.0	0.0	0.5	2.5	0.5	2.0	2.0	3.0	2.0	2.5	1.5	0.0

TABLE 27. EFFECT OF ODOUR CONTROL CHEMICALS ON ACTIVATED SLUDGE OXYGEN UPTAKE RATE

CHEMICAL ADDED	OXYGEN UPTAKE RATE (mg/l/hr.) AT % OF RECOMMENDED DOSAGE		
	1%	10%	50%
None	13.0	15.7	16.5
Freshette	14.4	14.8	14.5
Inca Gold	14.7	17.0	14.0
Corlon Chem-67	13.2	4.1	-

TABLE 28. EFFECT OF ODOUR CONTROL CHEMICALS ON pH OF BIOLOGICAL SYSTEM

CHEMICAL ADDED	pH AT % OF RECOMMENDED DOSAGE		
	1%	10%	50%
None	7.40	7.48	7.50
Freshette	7.50	7.62	7.50
Inca Gold	7.80	7.72	8.45
Corlon Chem-67	7.50	6.98	-

FIGURES

FIGURE 1

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

Low Urine Sewage Sample

Contact Time - 4 hours

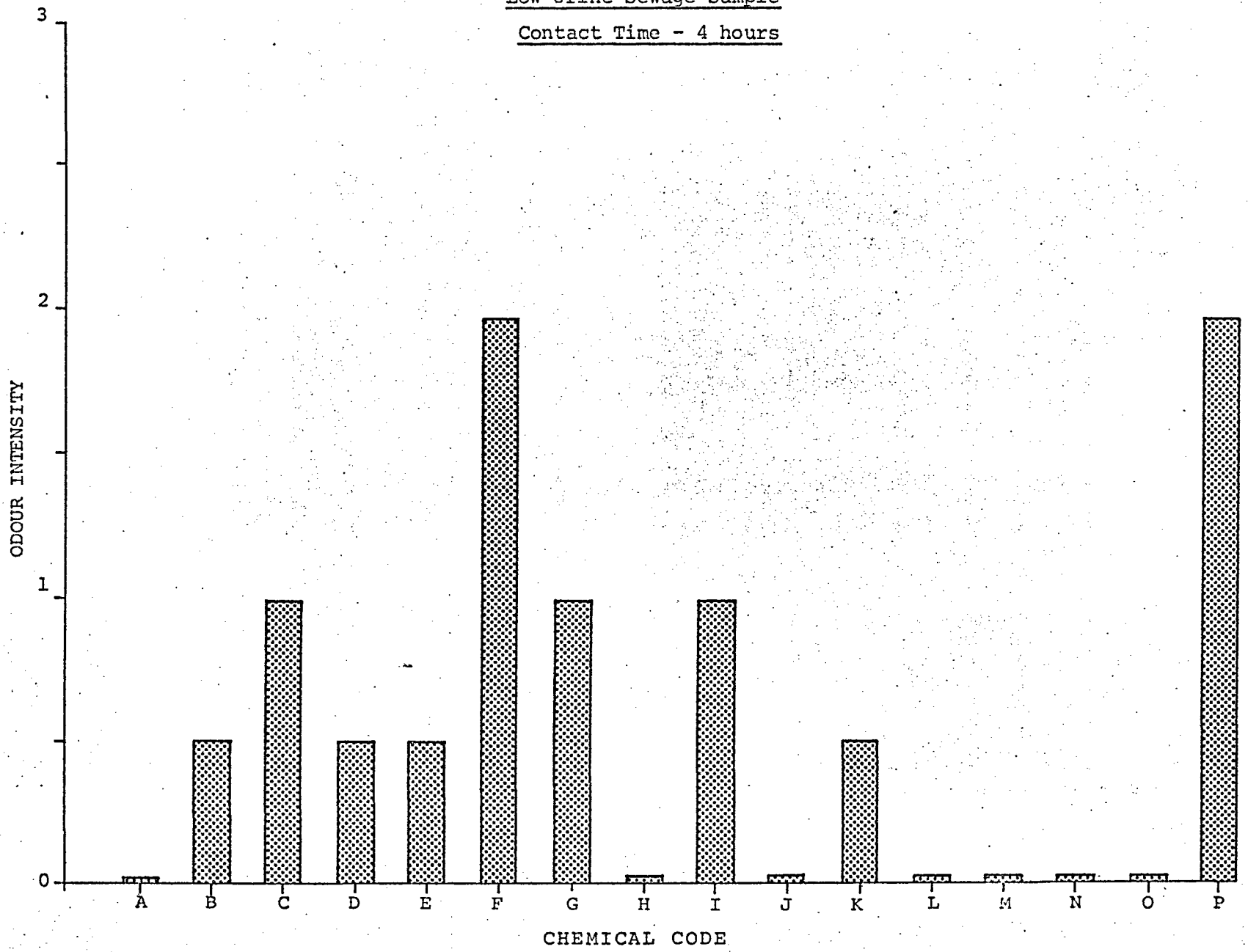

FIGURE 2

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

Low Urine Sewage Sample

Contact Time - 2 days

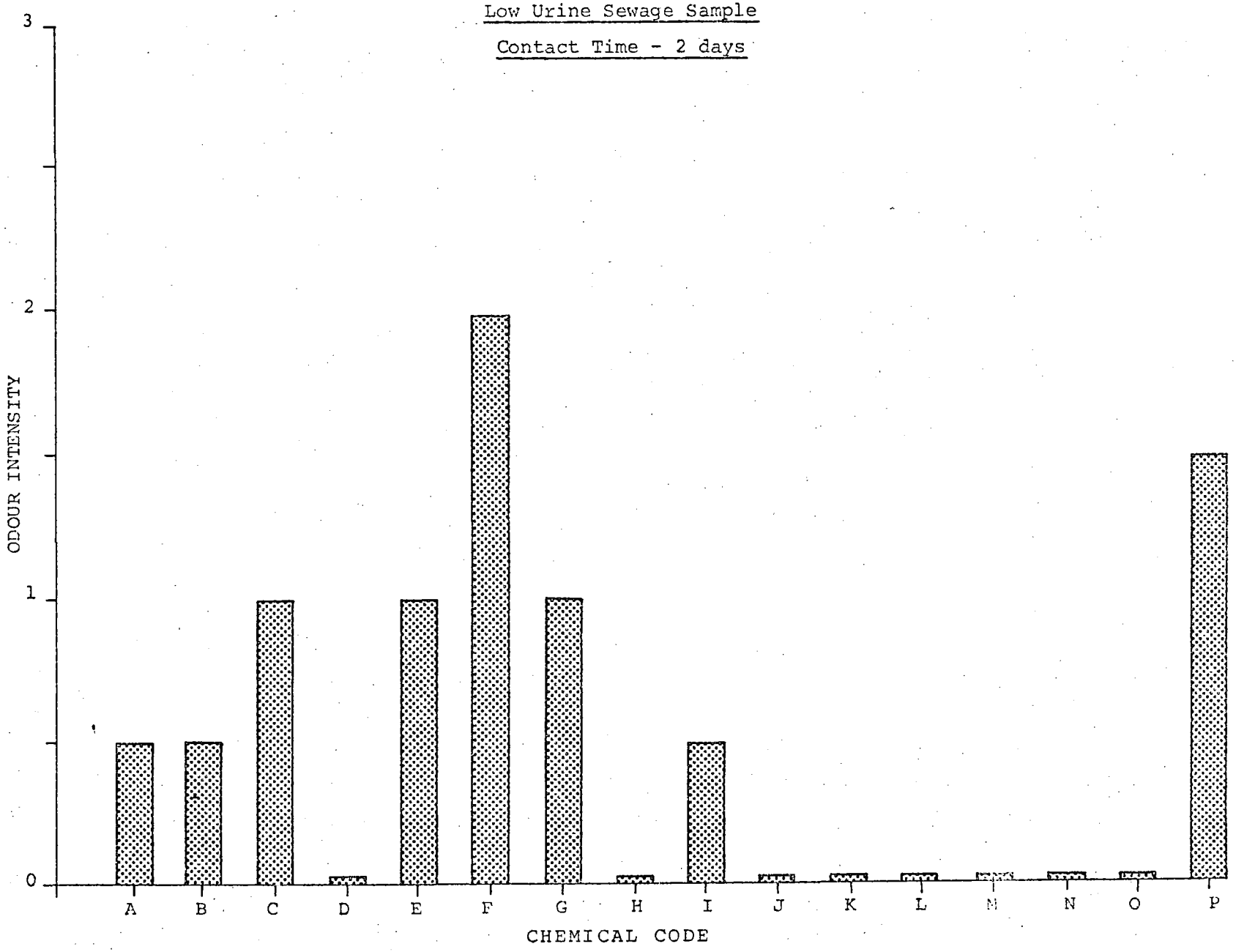

FIGURE 3 RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

Low Urine Sewage Sample

Contact Time - 7 days

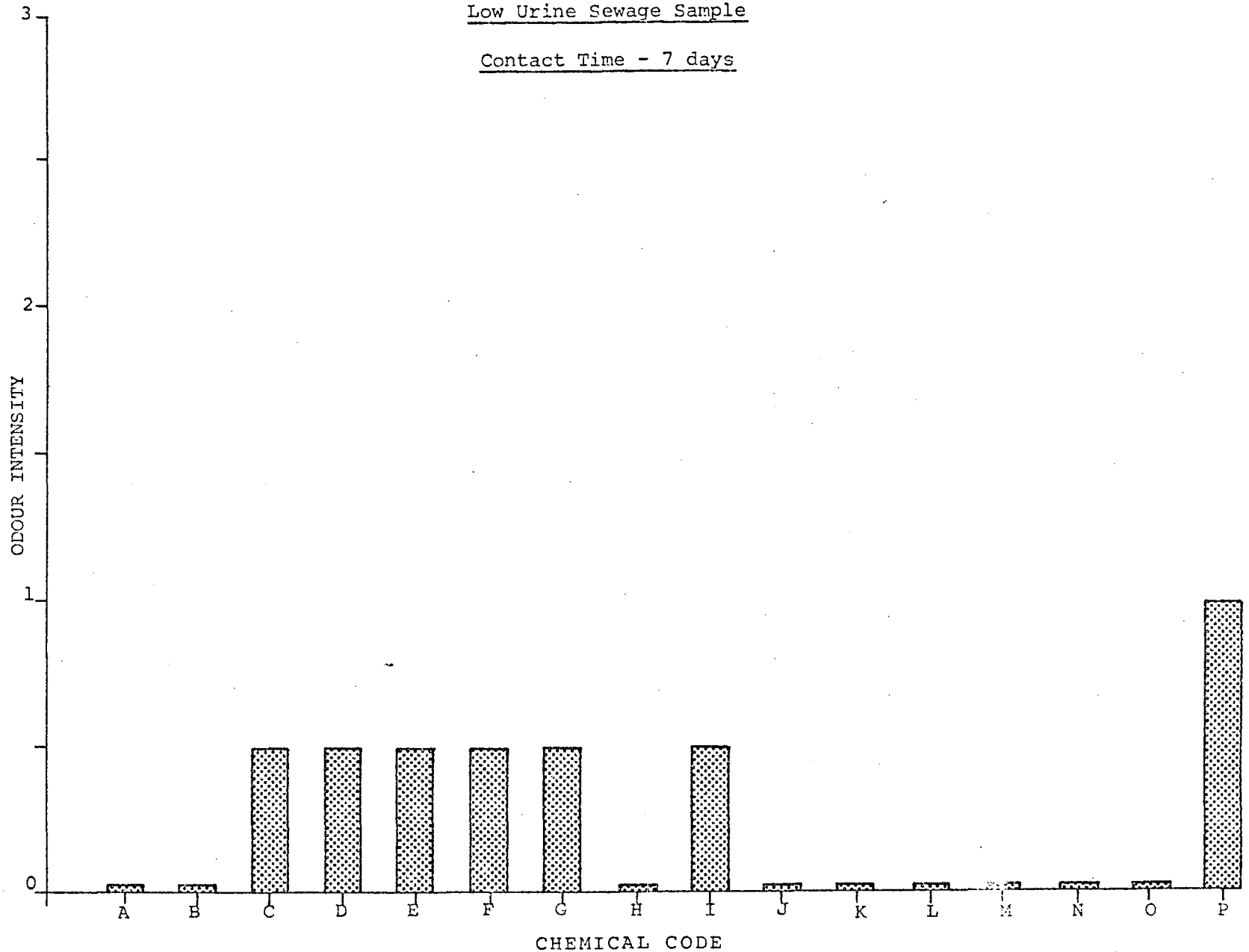

FIGURE 4

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

Low Urine Sewage Sample

Contact Time - 14 days

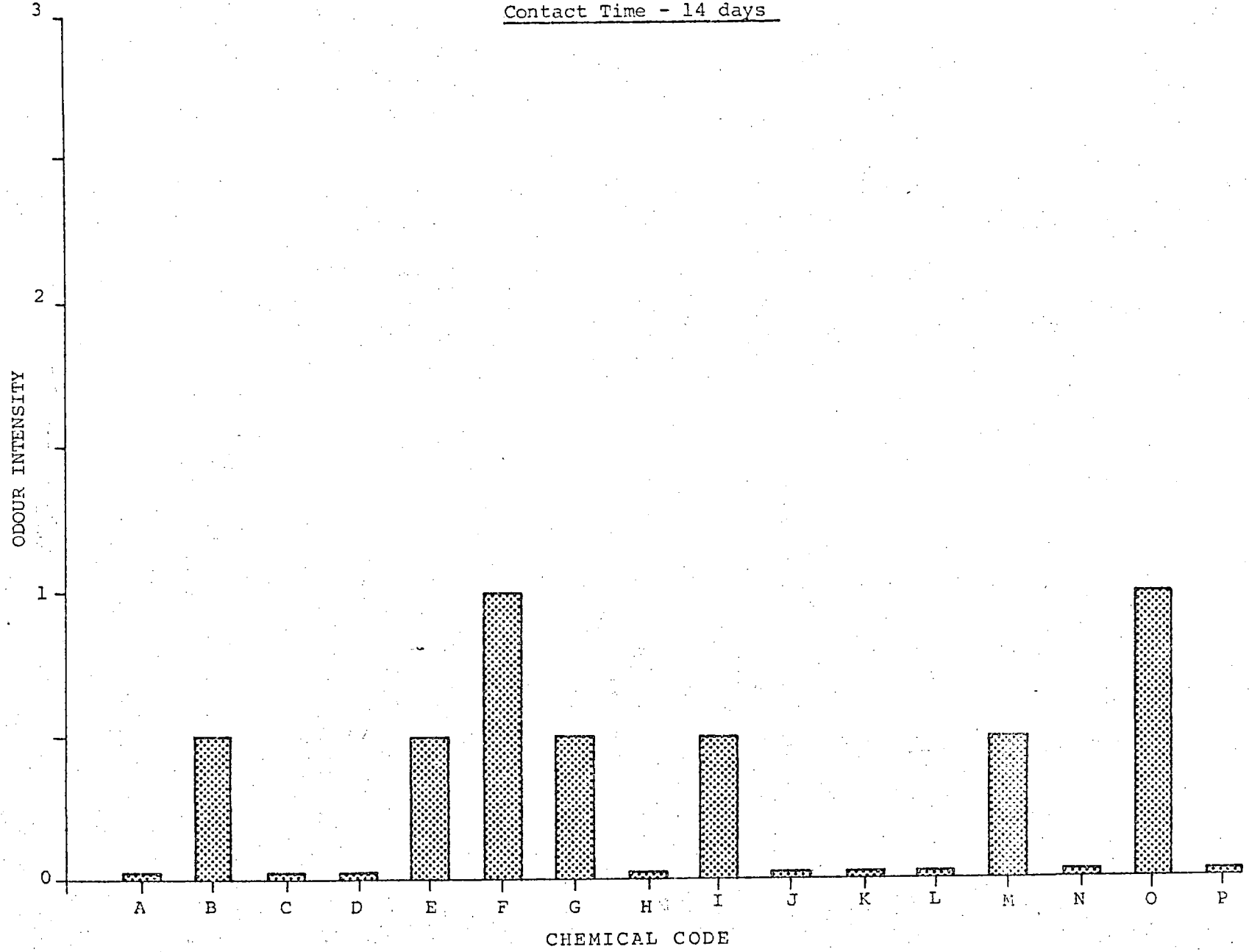

FIGURE 5

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

High Urine Sewage Sample

Contact Time - 4 hours

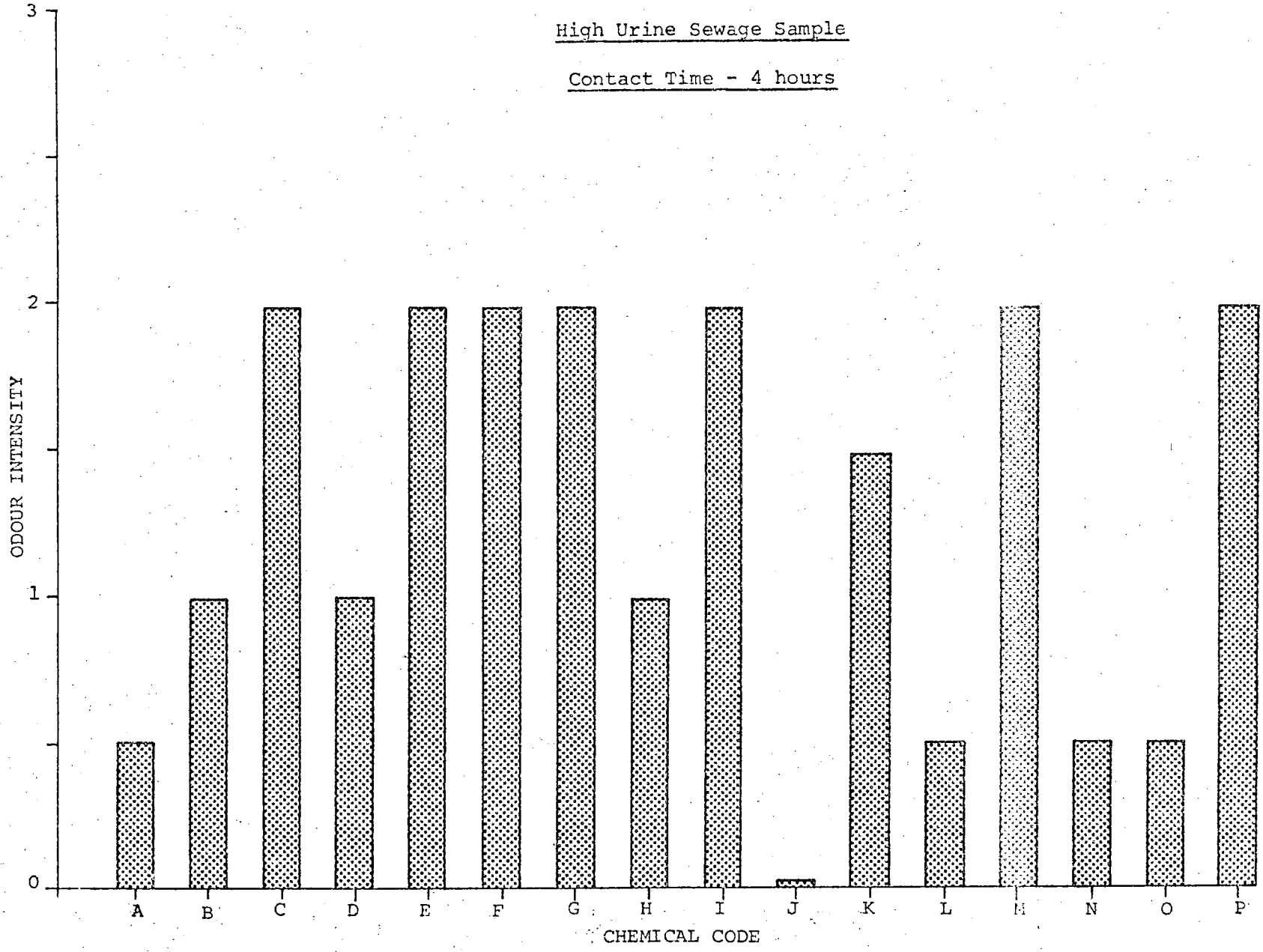

FIGURE 6

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

High Urine Sewage Sample

Contact Time - 2 days

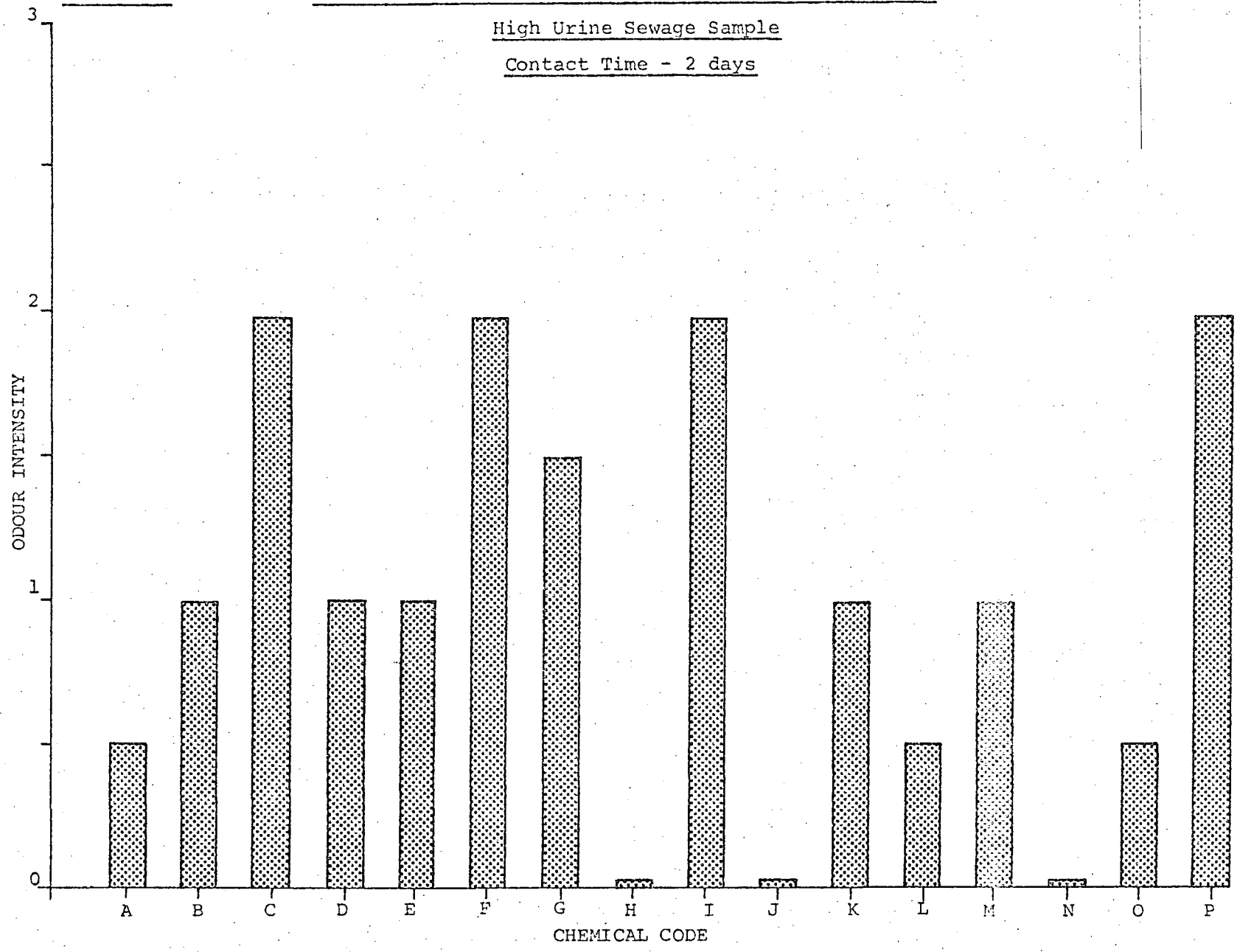

FIGURE 7

RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

High Urine Sewage Sample

Contact Time - 7 days

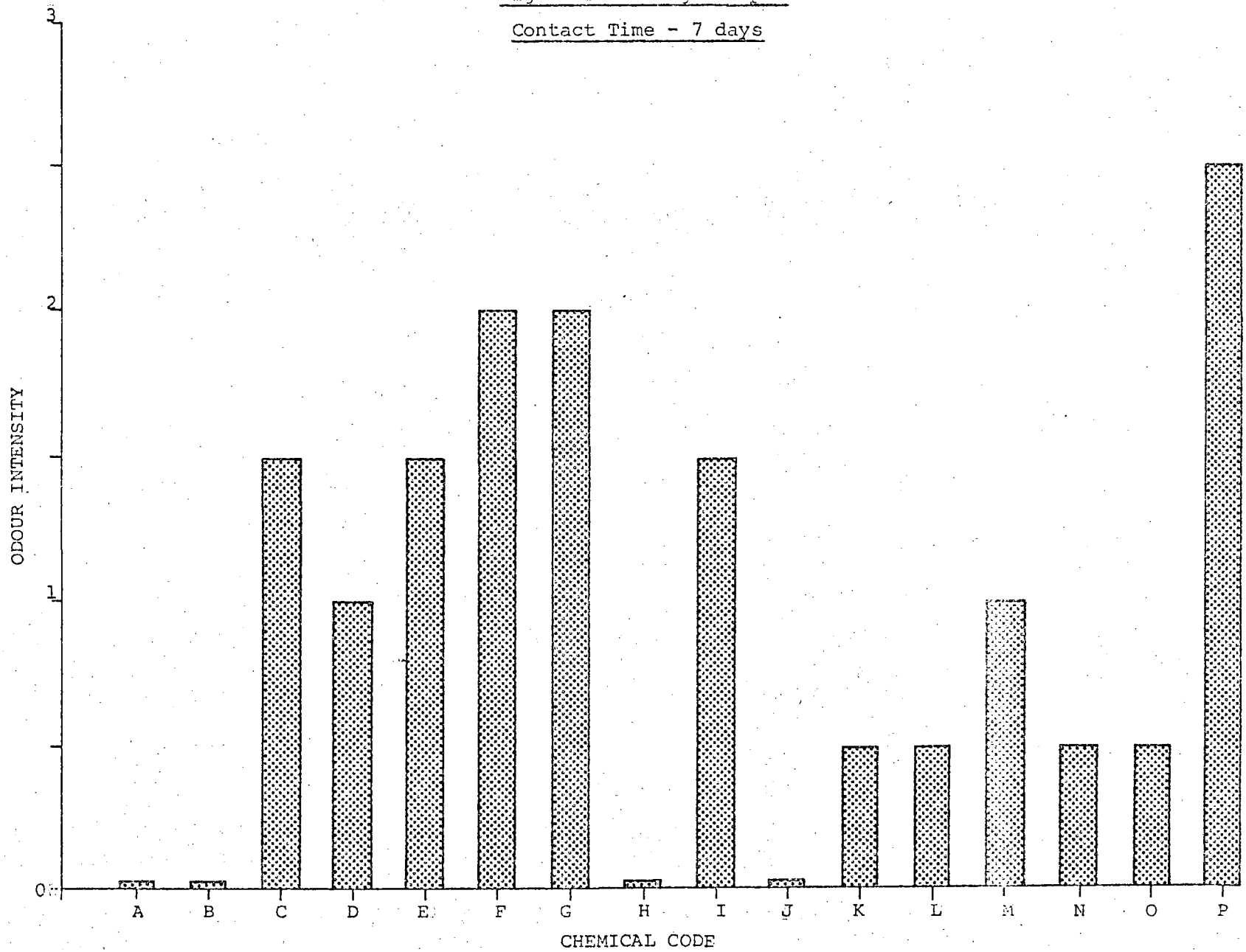

FIGURE 8 RELATIVE SEWAGE ODOUR AT RECOMMENDED CHEMICAL DOSAGE

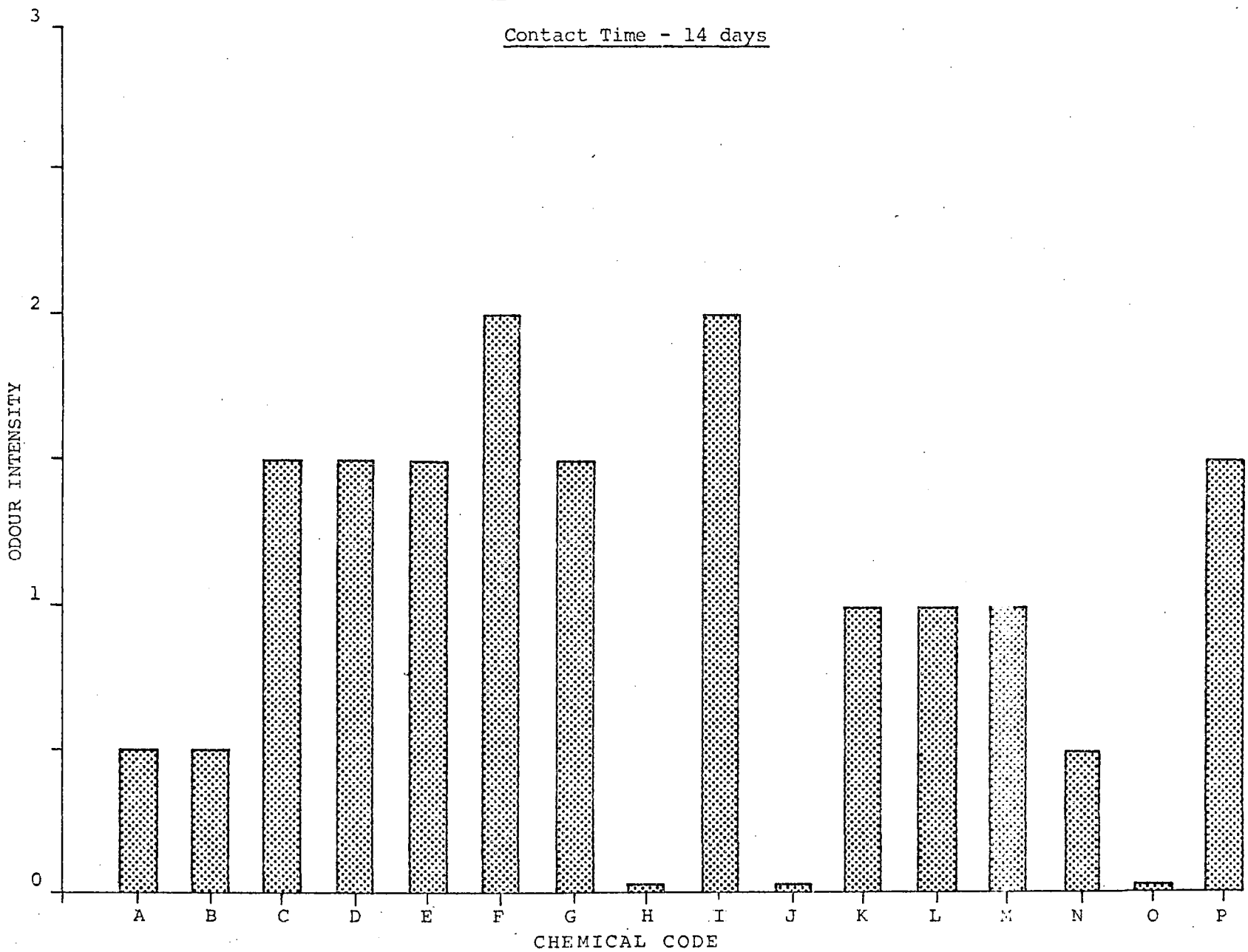

FIGURE 9

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Aqua-Kem (Code A)
Recommended Dosage

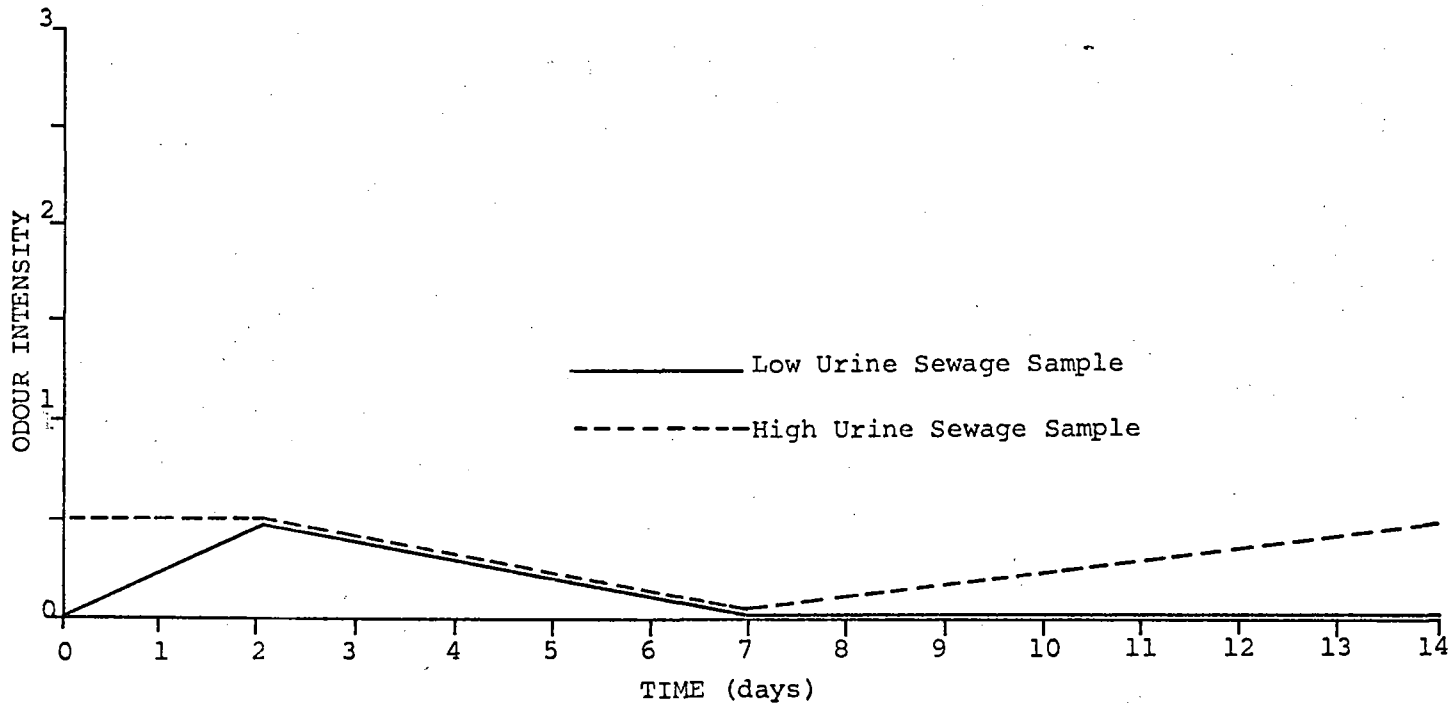

FIGURE 10 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: C-0061 (Code B)

Recommended Dosage

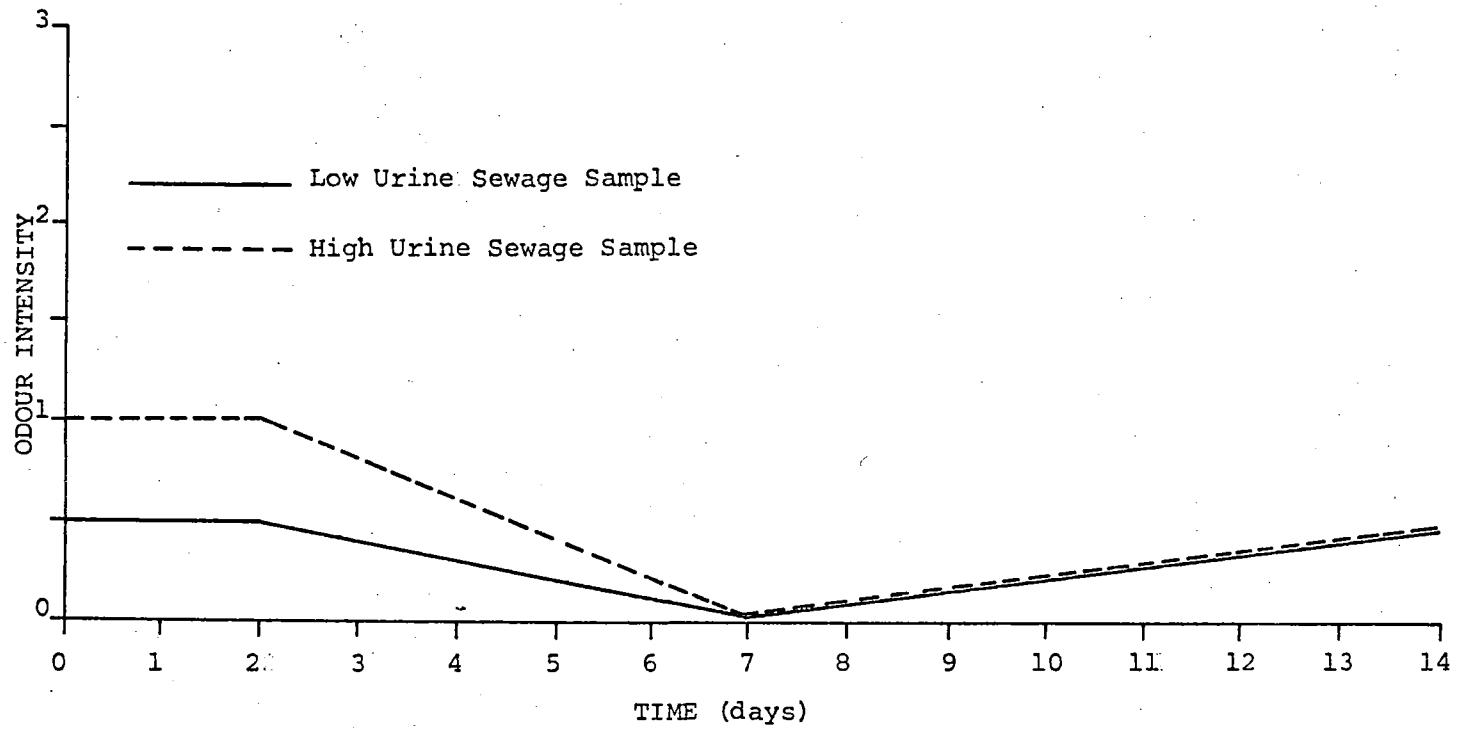

FIGURE 11

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Consan 20 (Code C)
Recommended Dosage

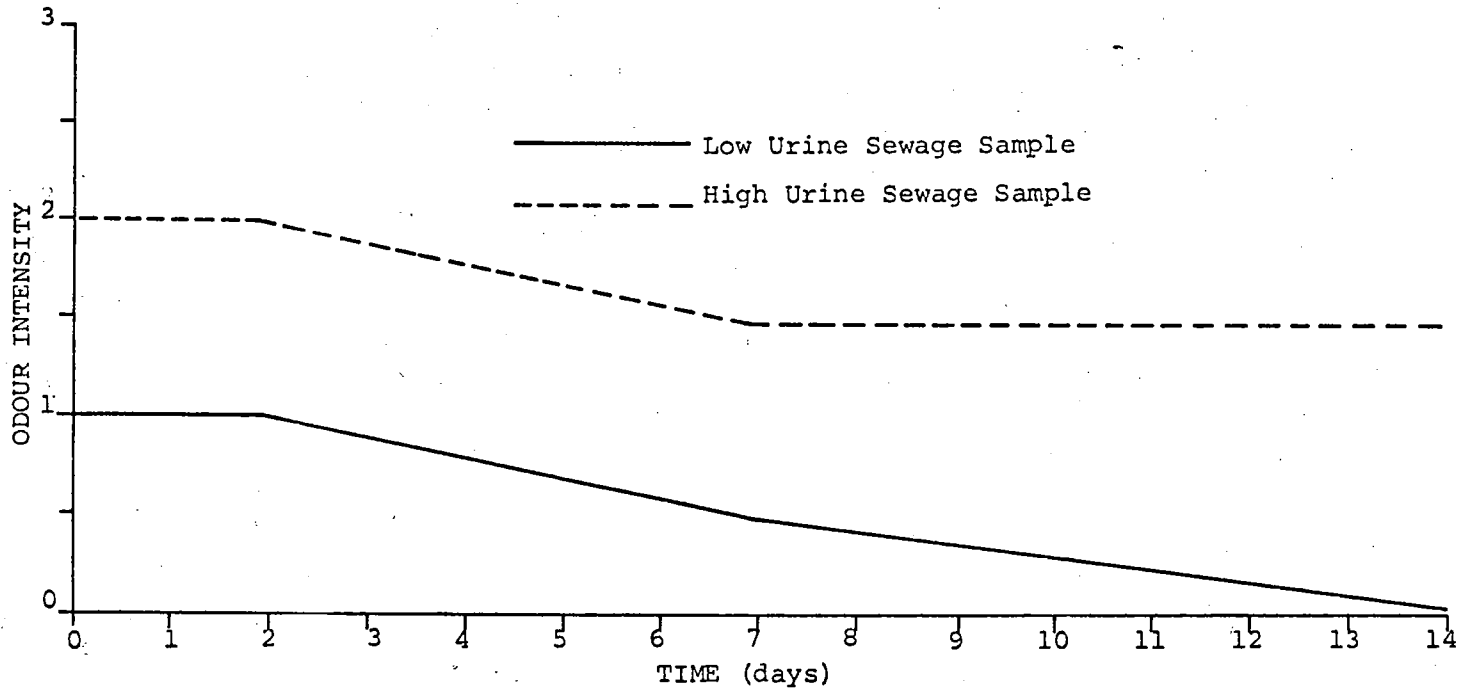

FIGURE 12 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Corlon Chem - 67 (Code D)
Recommended Dosage

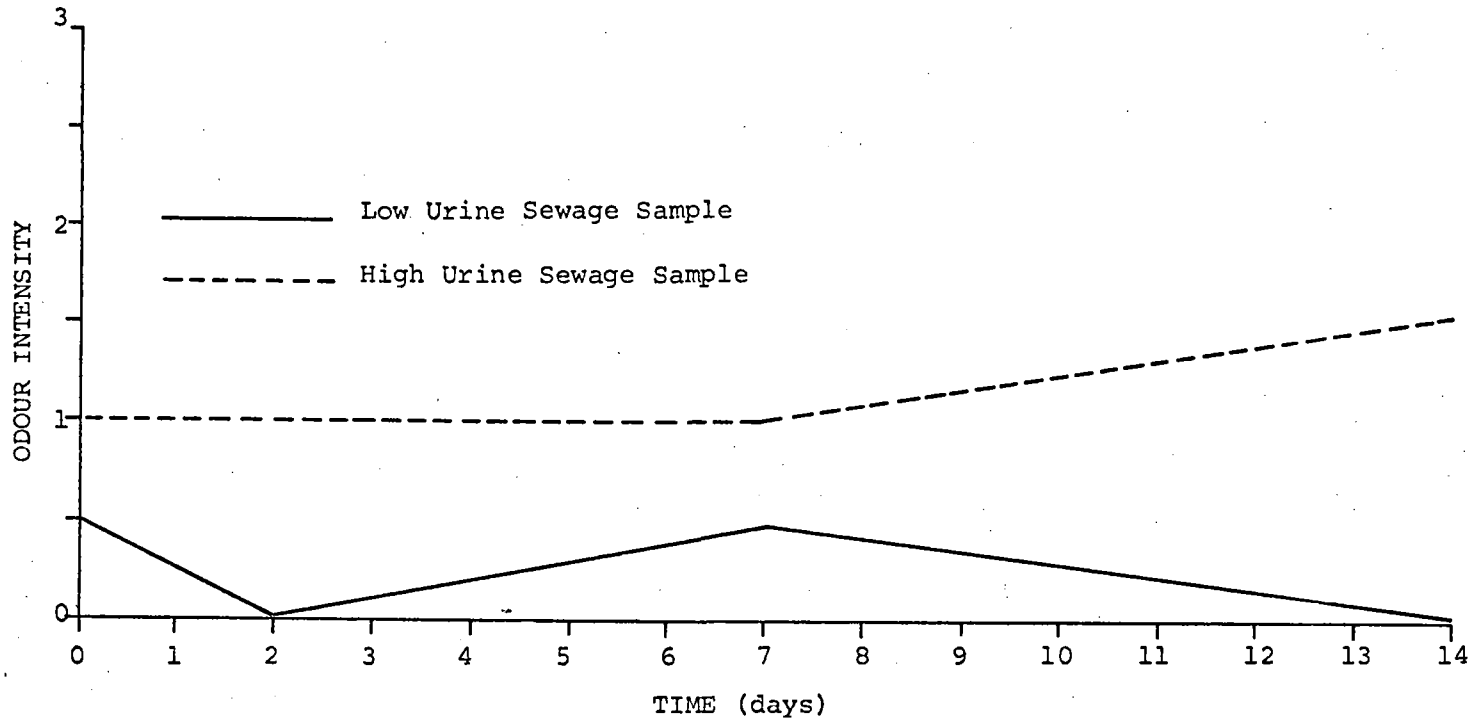

FIGURE 13

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Elsan Blue (Code E)

Recommended Dosage

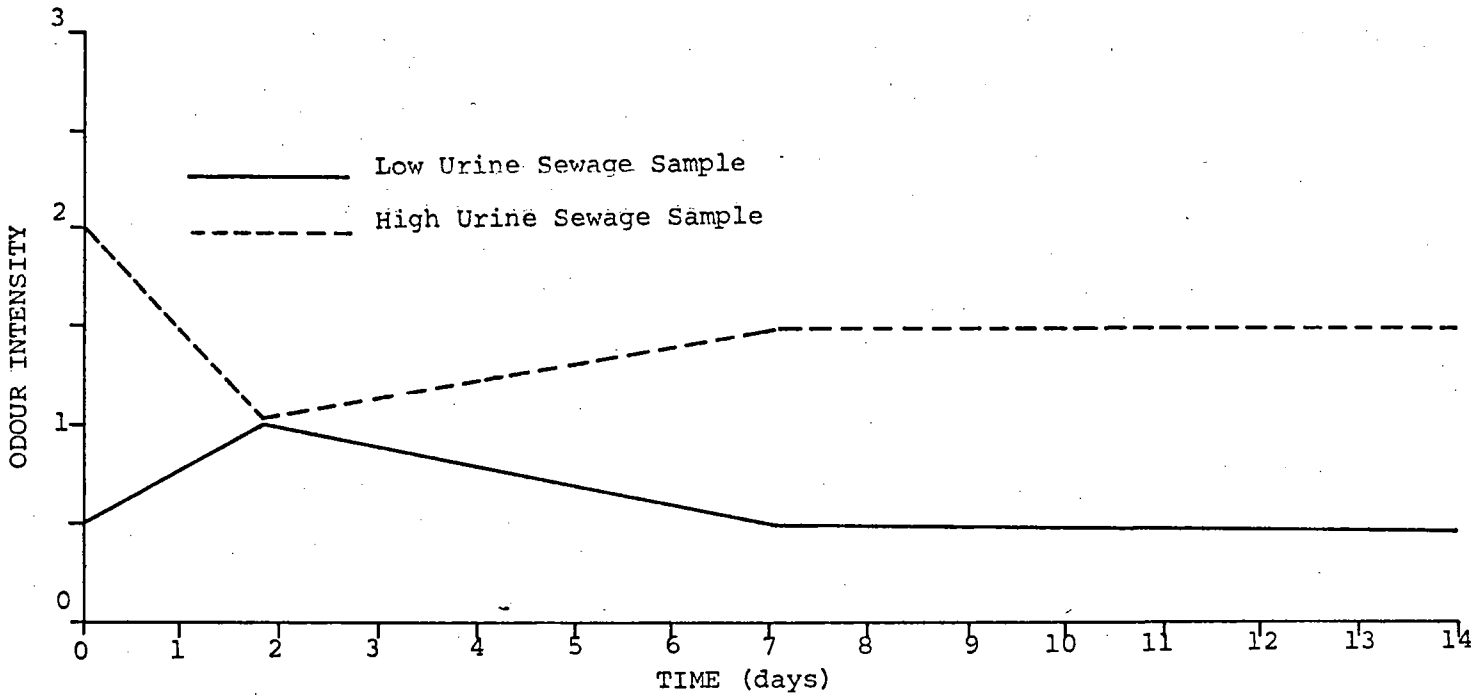

FIGURE 14

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Freshette (Code F)
Recommended Dosage

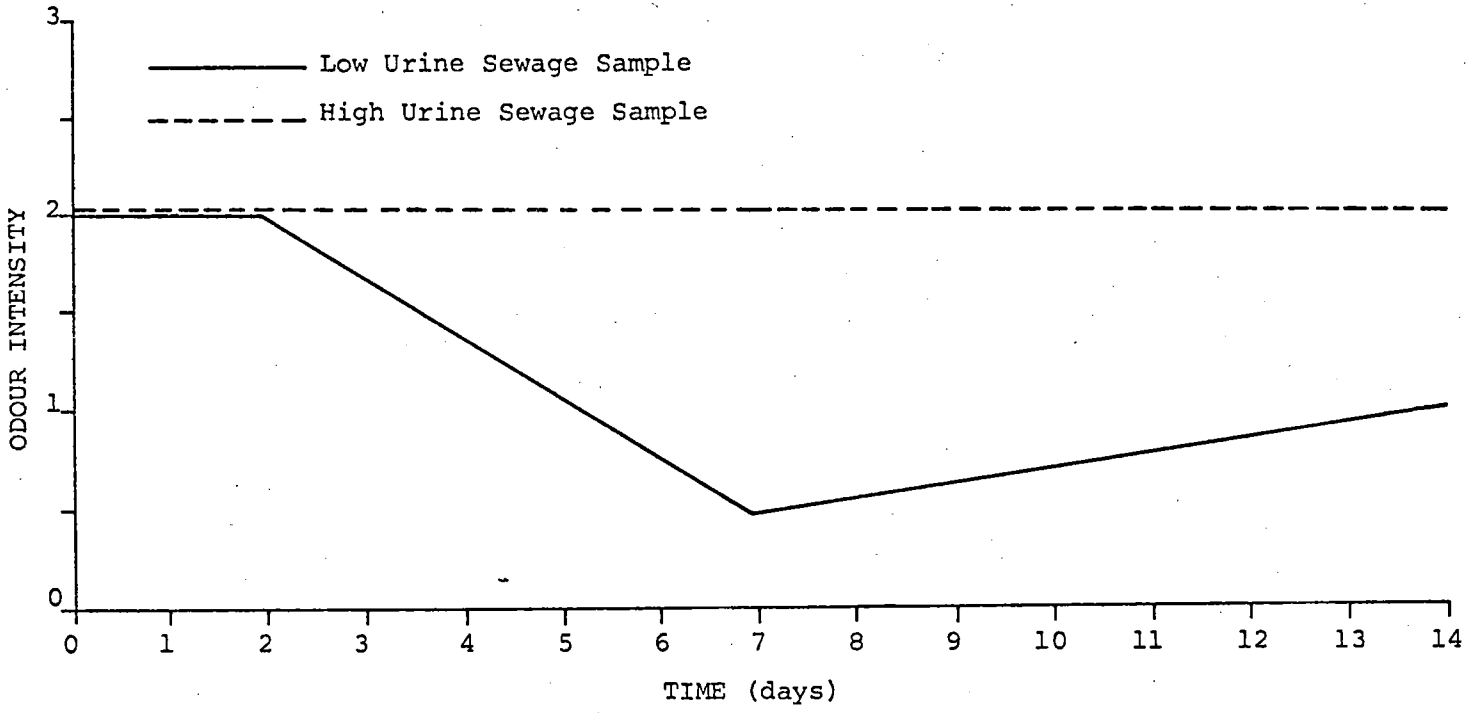

FIGURE 15 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Headomatic Powder (Code G)
Recommended Dosage

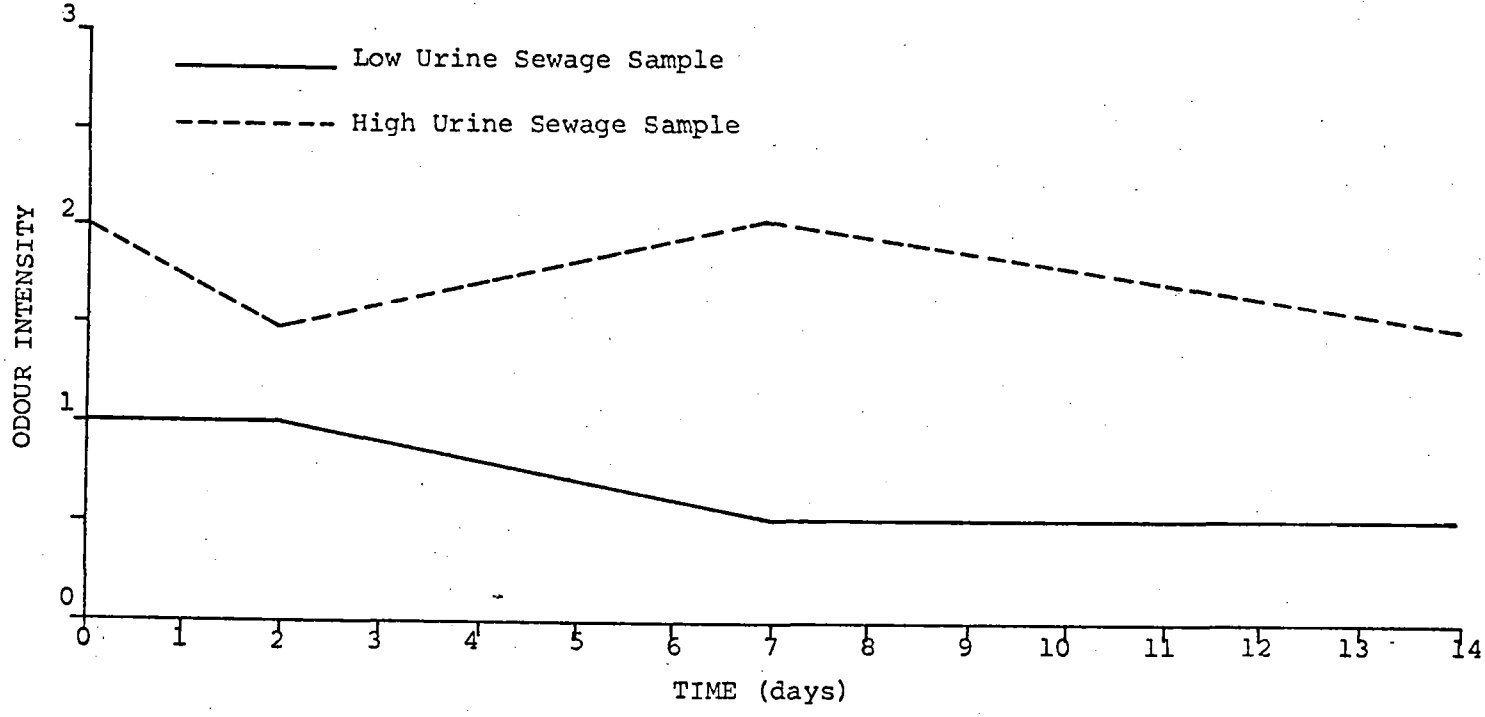

FIGURE 16

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Inca Gold (Code H)

Recommended Dosage

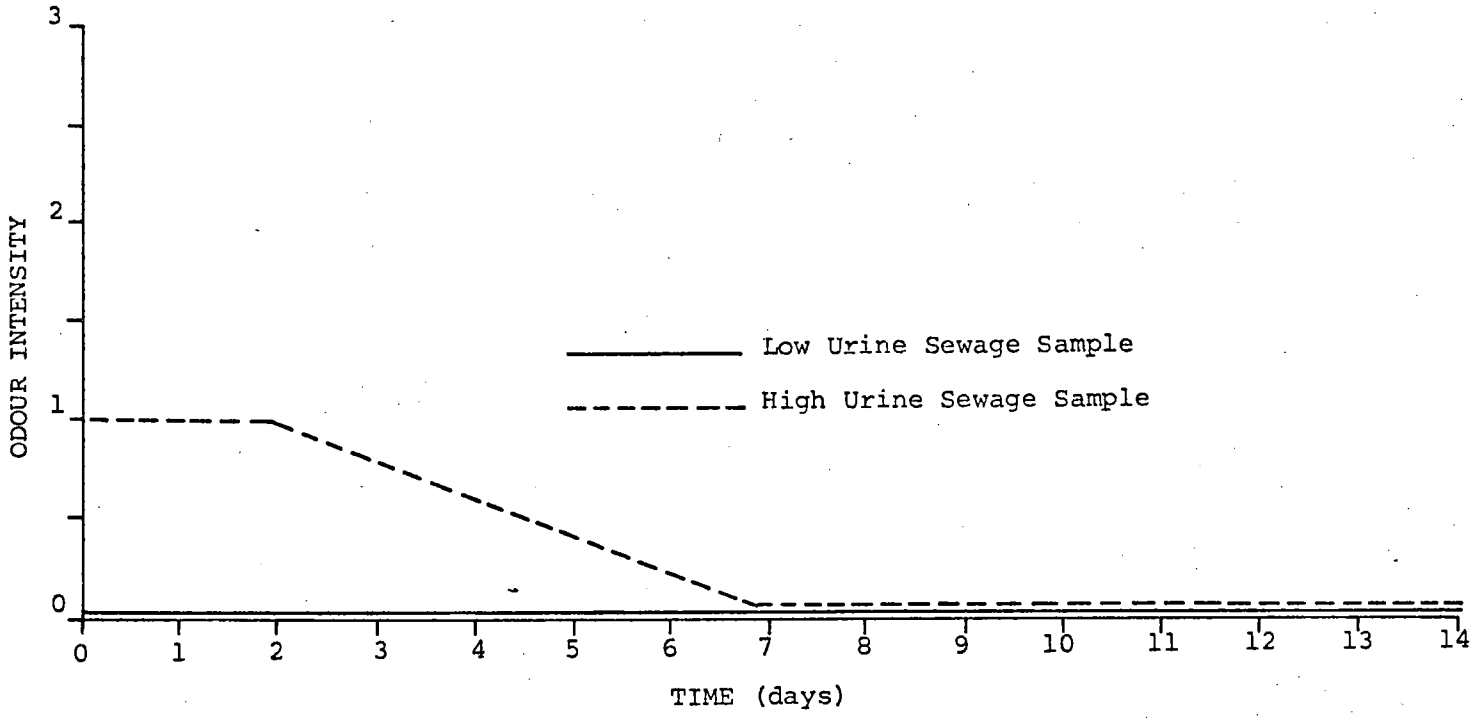

FIGURE 17

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Kn - 48 (Code I)
Recommended Dosage

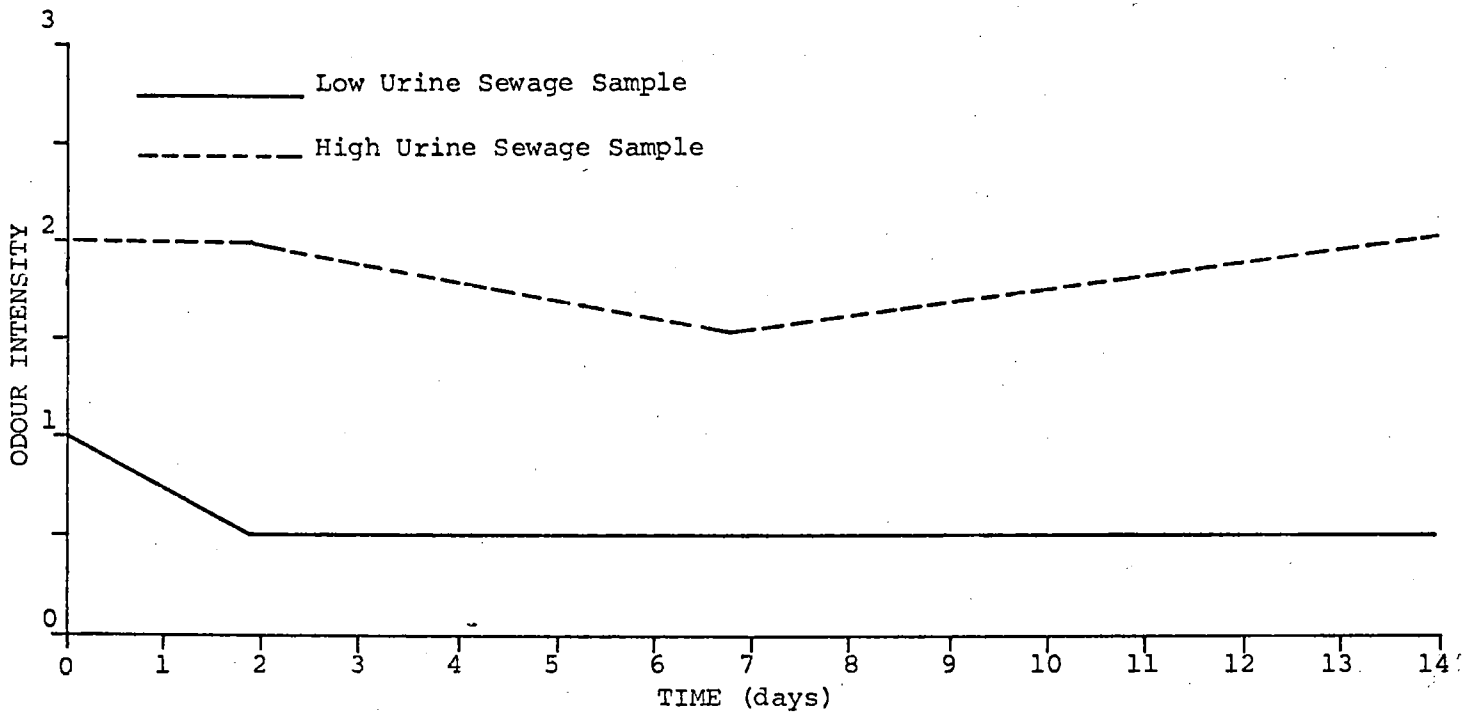

FIGURE 18

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: M^C 1000 (Code J)
Recommended Dosage

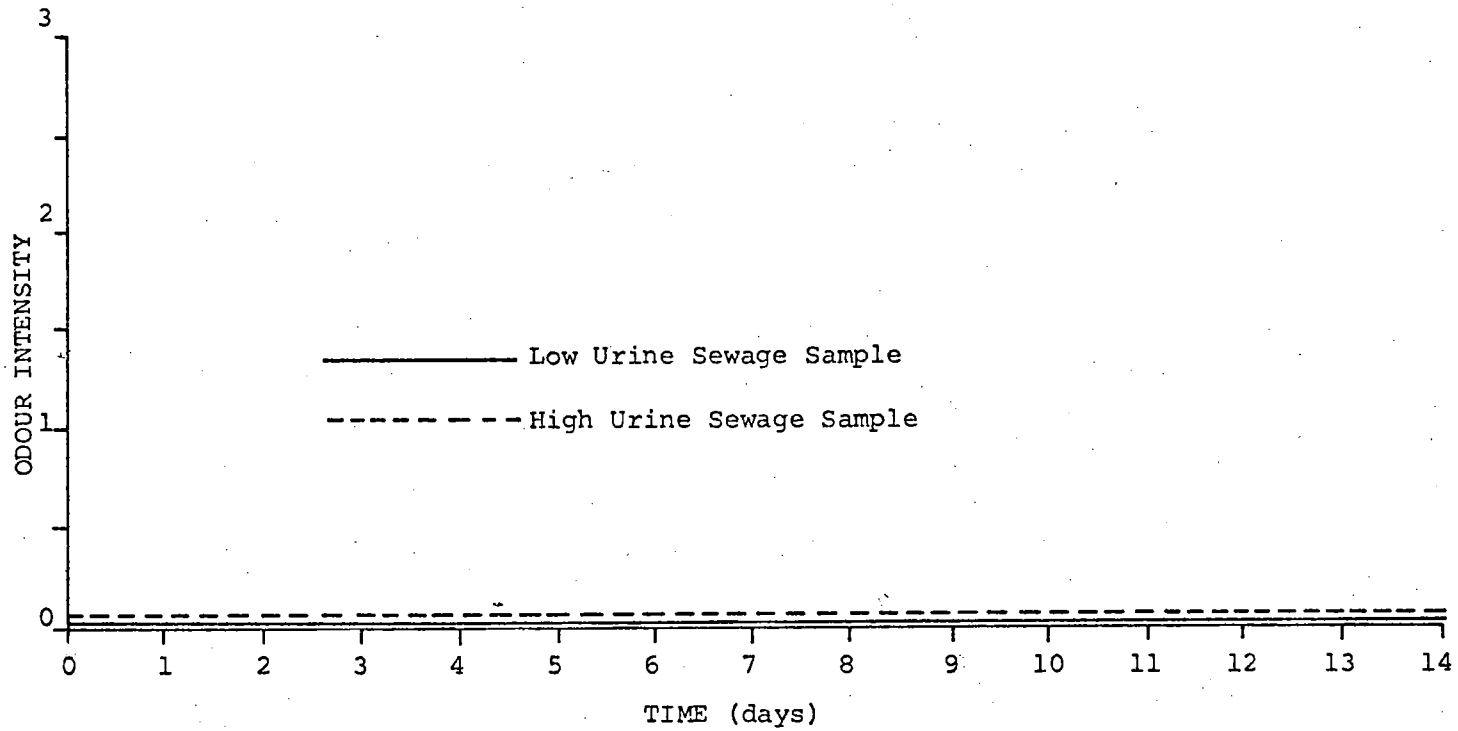

FIGURE 19 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Mobile Toilet Deodorant (Code K)

Recommended Dosage

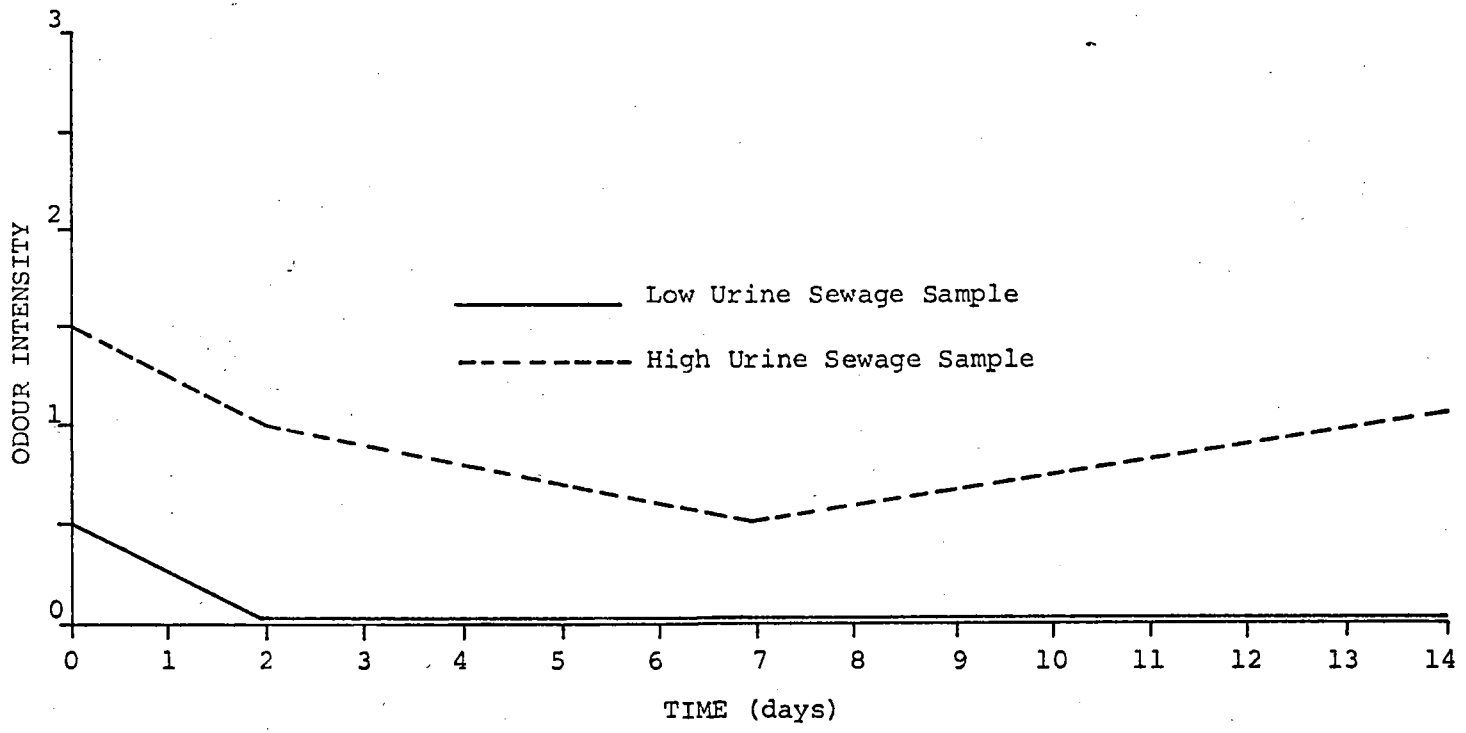

FIGURE 20

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Monochem T-5 (Code L)
Recommended Dosage

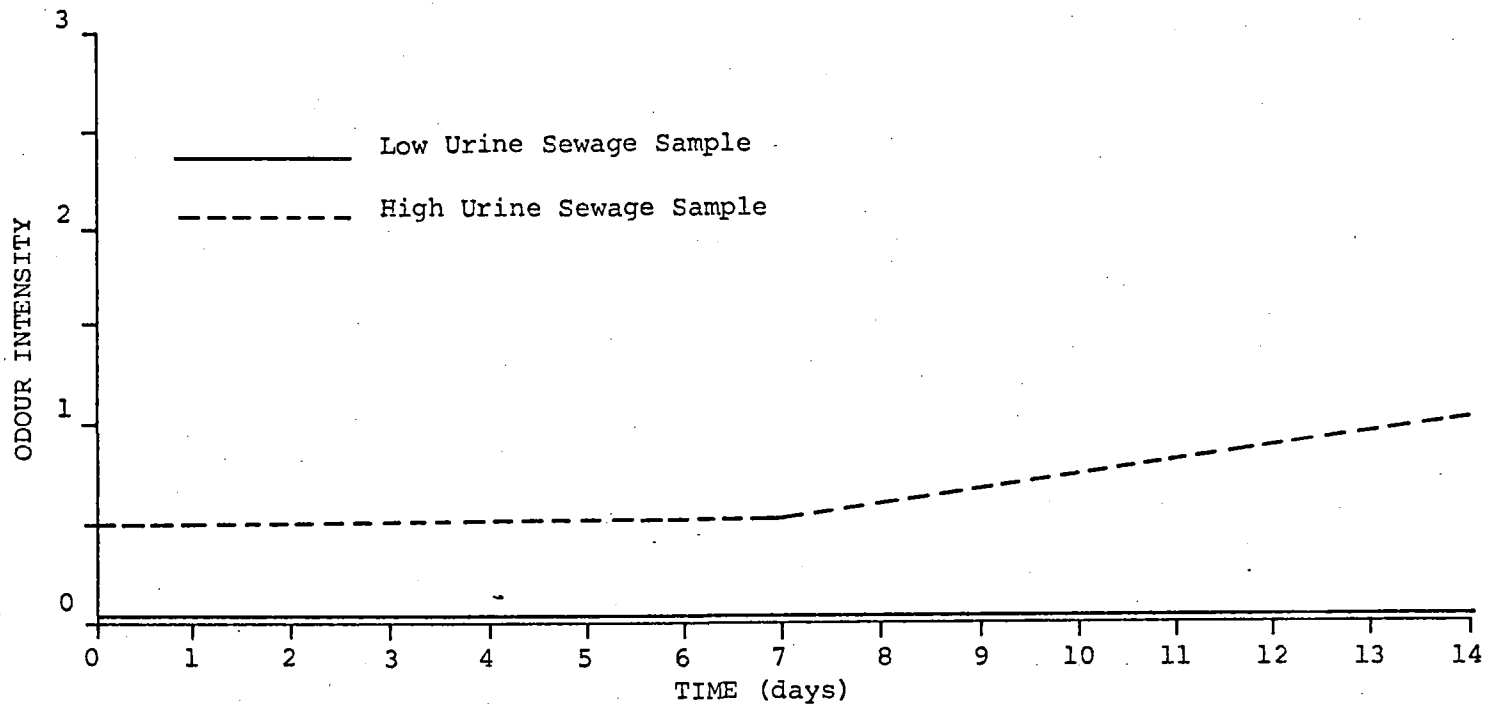

FIGURE 21

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: PTC (Code M)

Recommended Dosage

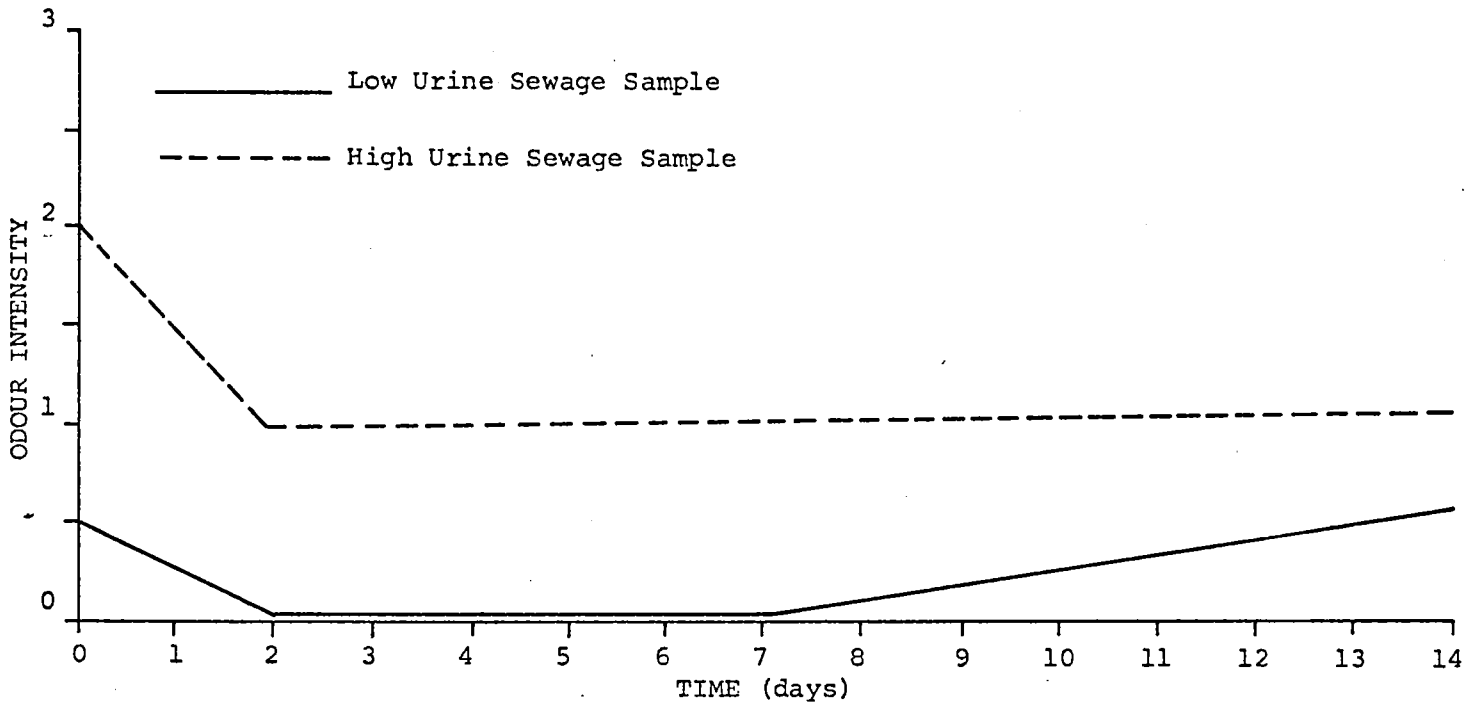

FIGURE 22

EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Sani Majik (Code N)

Recommended Dosage

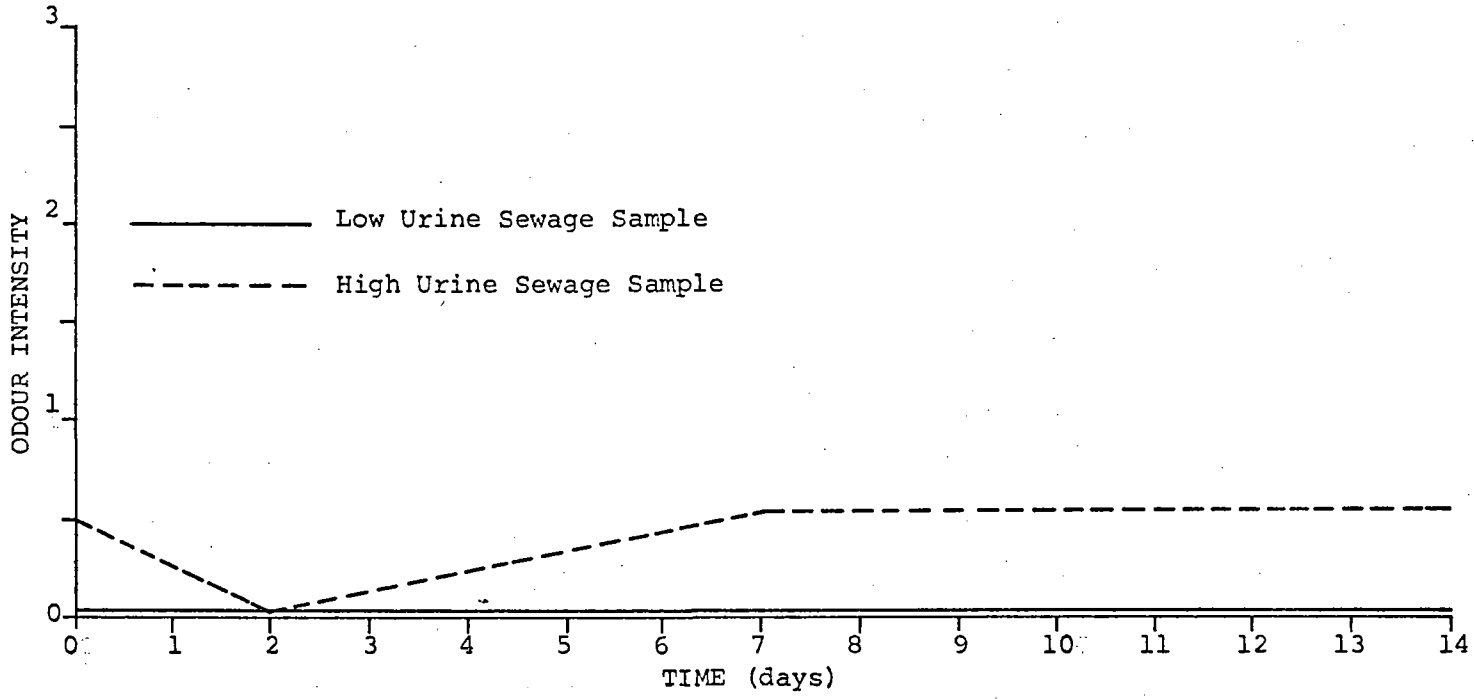

FIGURE 23 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Sanitor Fluid (Code 0)
Recommended Dosage

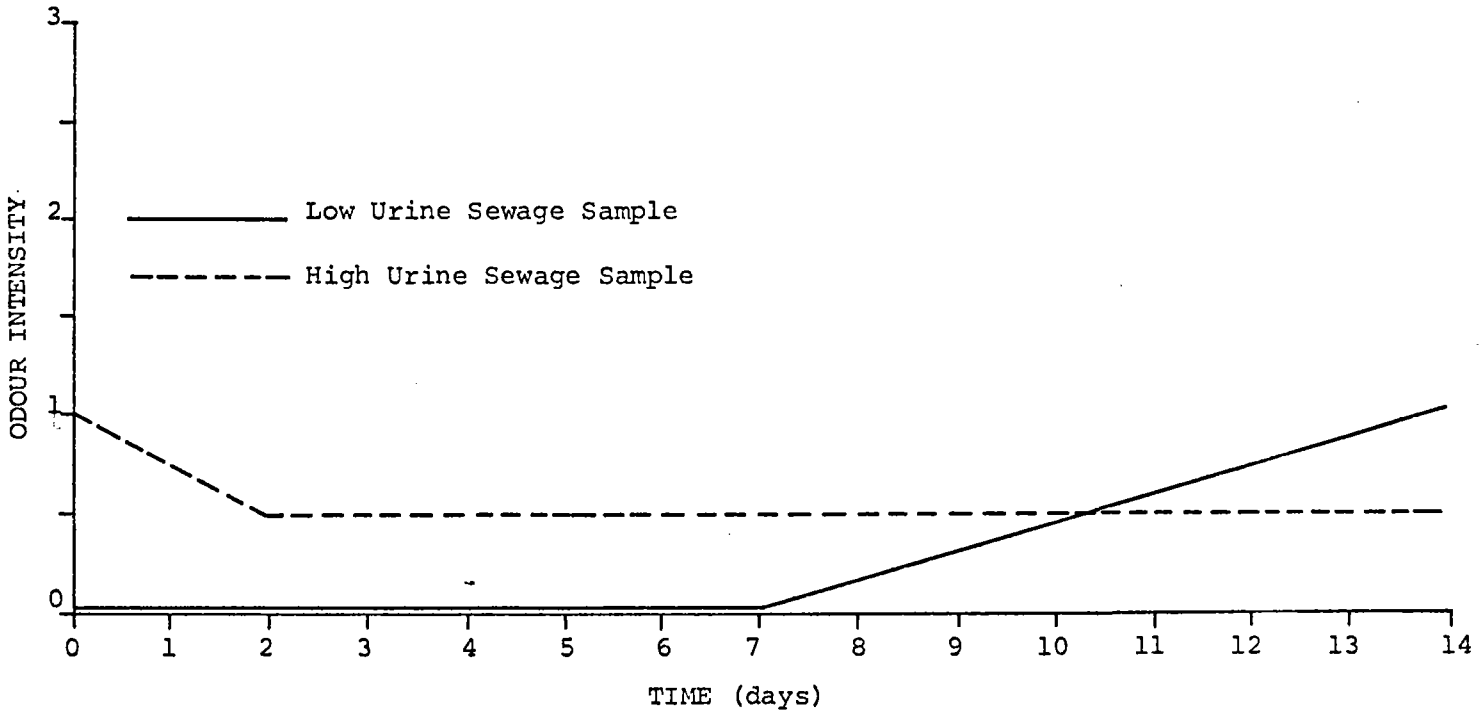

FIGURE 24 EFFECT OF TIME ON CHEMICAL EFFICIENCY

Chemical: Micro-Aid (Code P)

Recommended Dosage

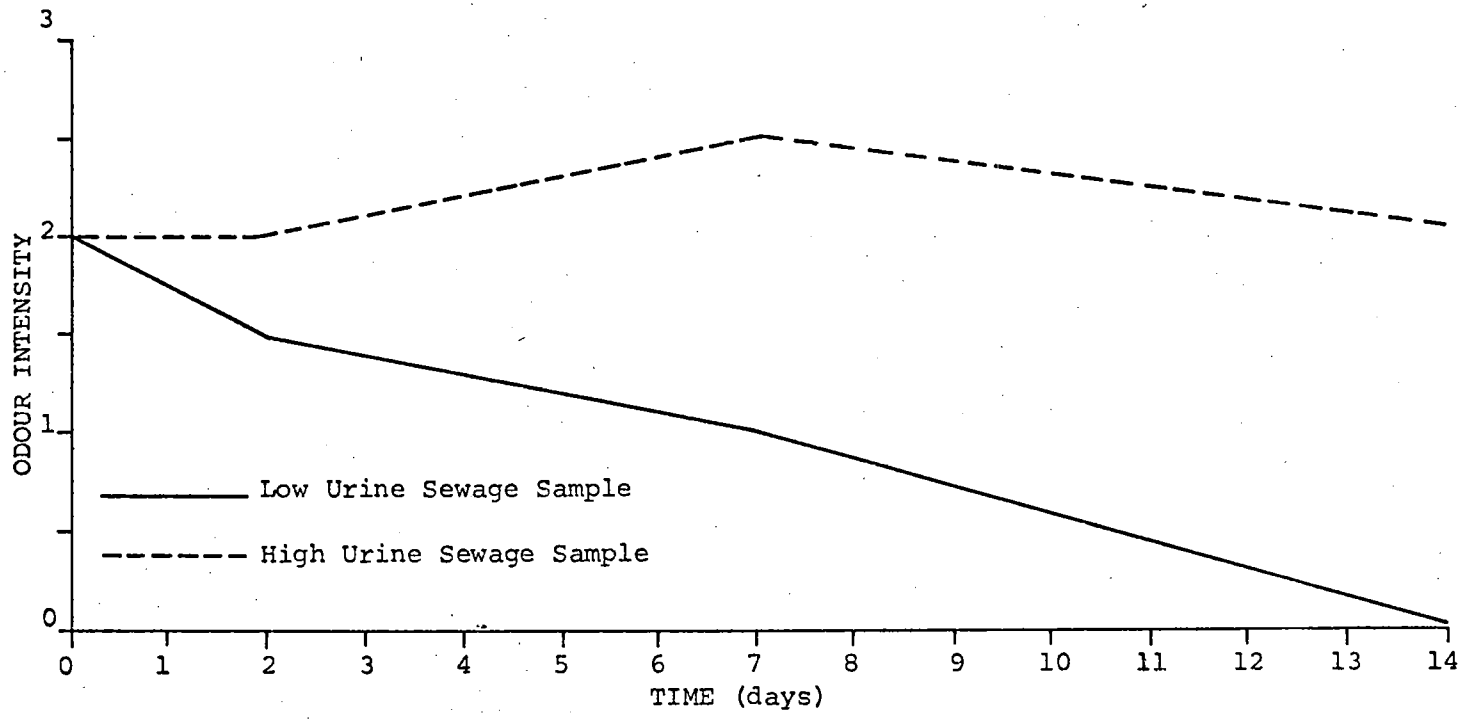

FIGURE 25 RELATIVE SEWAGE ODOUR AT 10% OF RECOMMENDED CHEMICAL DOSAGE

Low Urine Sample; 4 hour Contact Time

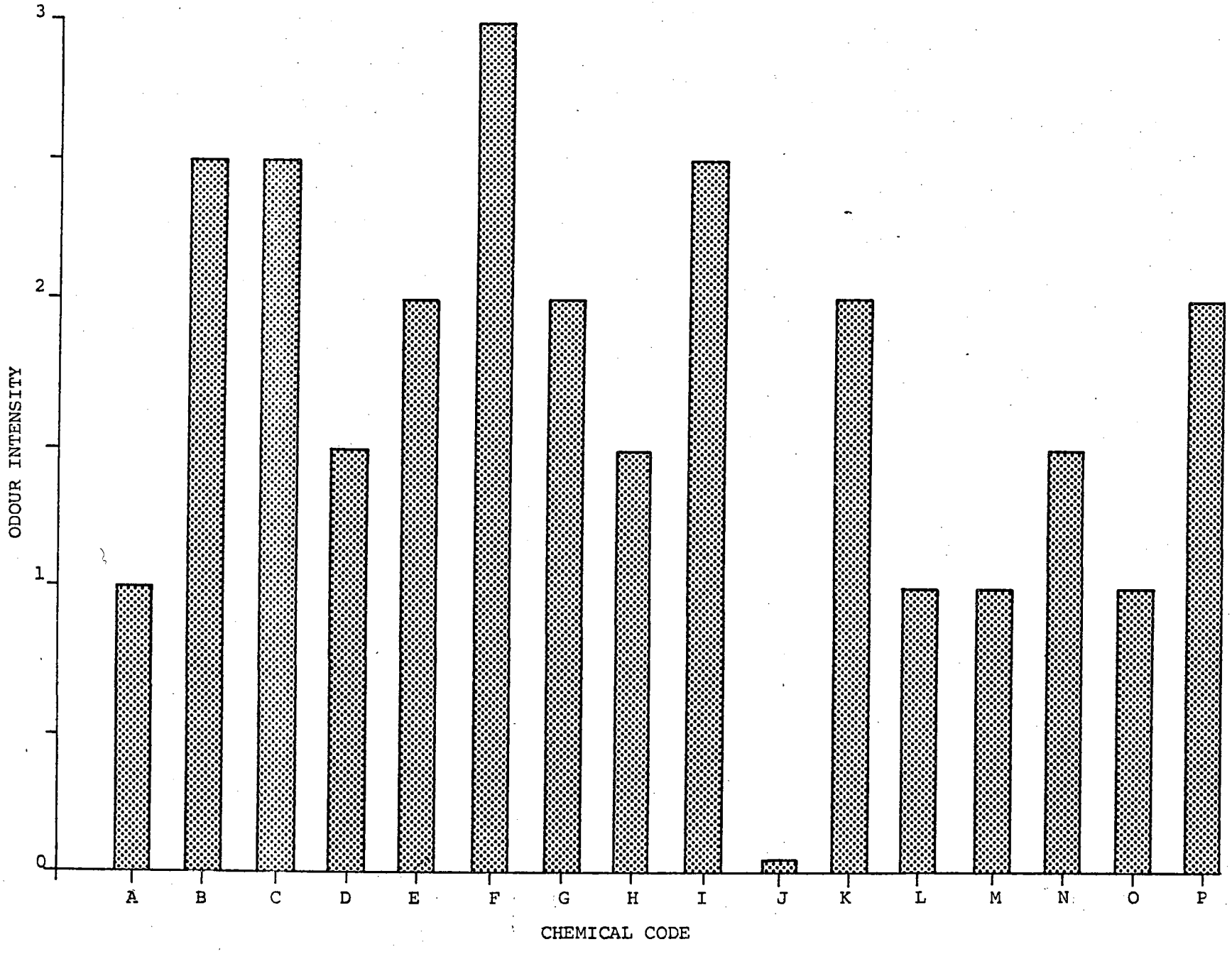

FIGURE 26 RELATIVE SEWAGE ODOUR AT 10% OF RECOMMENDED CHEMICAL DOSAGE

Low Urine Sample; 14 days Contact Time

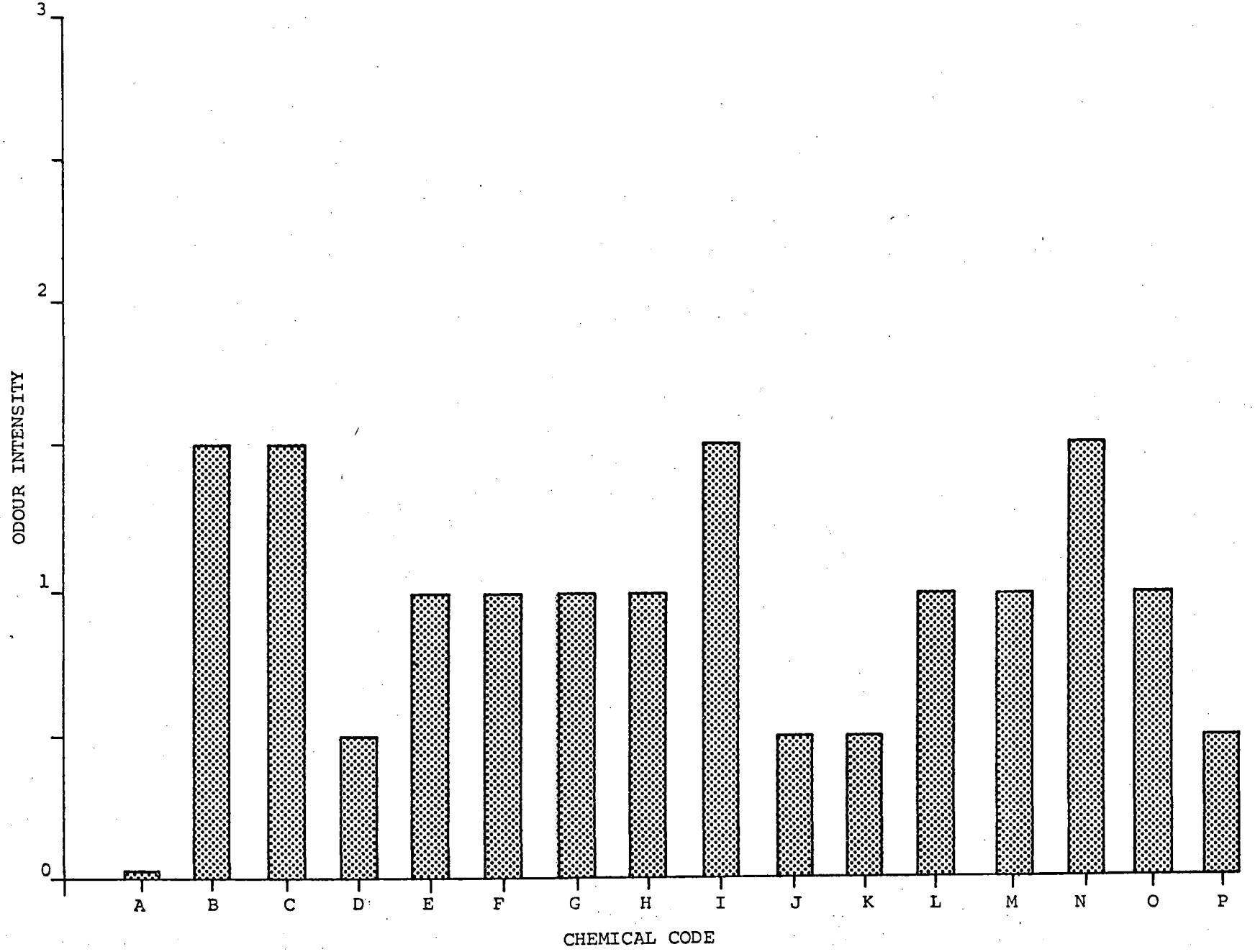

FIGURE 27 RELATIVE SEWAGE ODOUR AT 10% OF RECOMMENDED CHEMICAL DOSAGE

High Urine Sample; 4 hour Contact Time

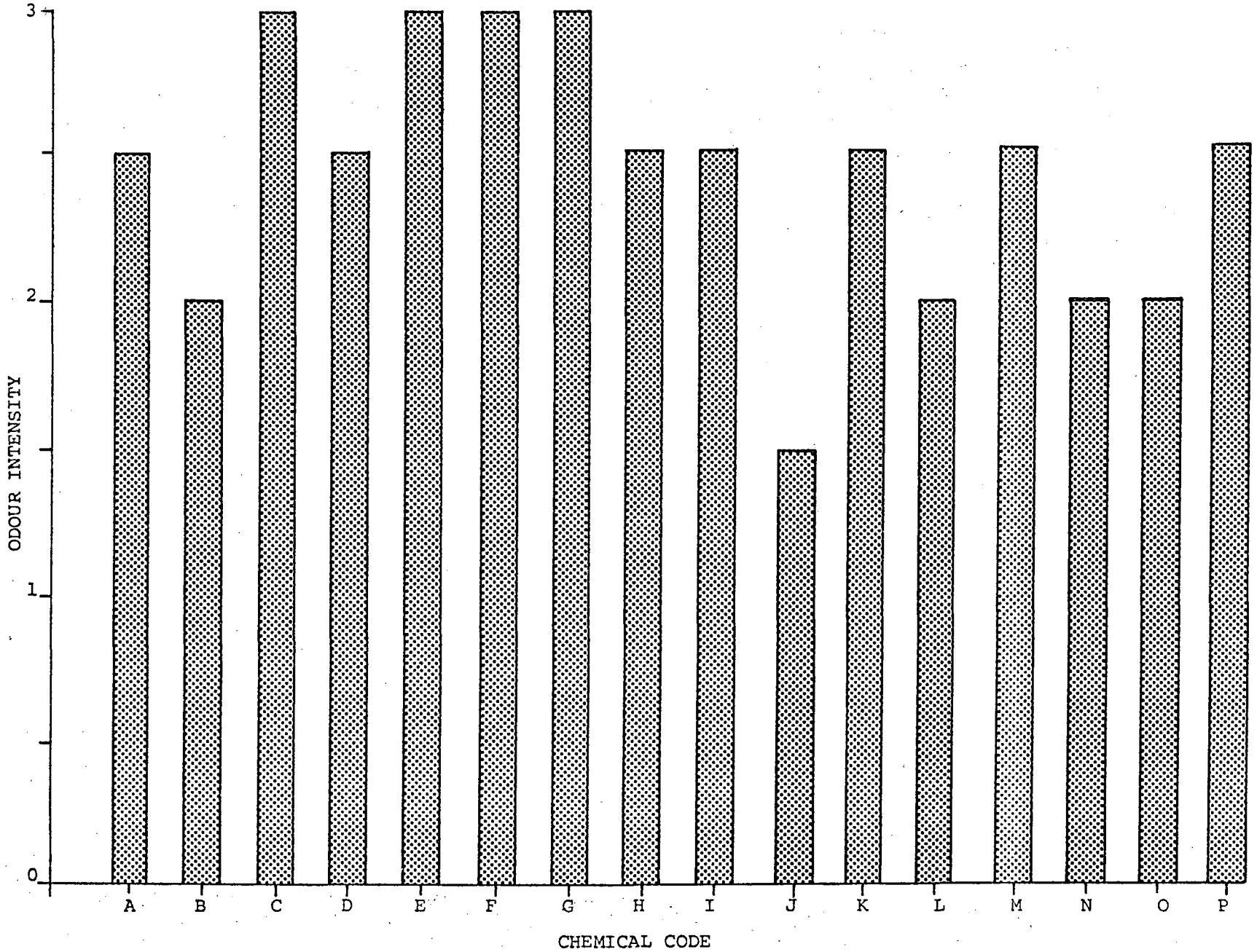

FIGURE 28 RELATIVE SEWAGE ODOUR AT 10% OF RECOMMENDED CHEMICAL DOSAGE

High Urine Sample; 14 days Contact Time

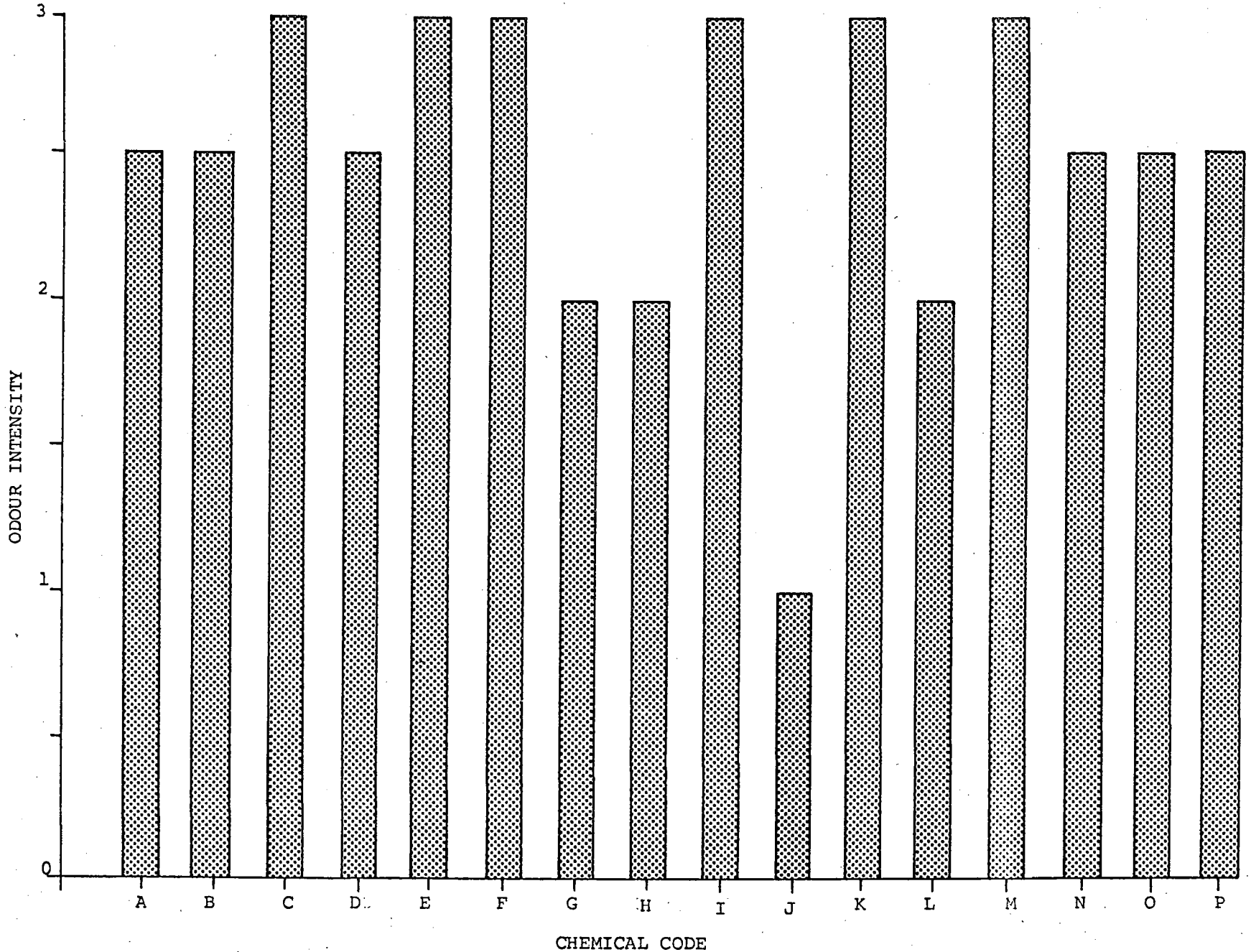

FIGURE 29 RELATIVE SEWAGE ODOUR AT 50% OF RECOMMENDED CHEMICAL DOSAGE

Low Urine Sample; 4 hour Contact Time

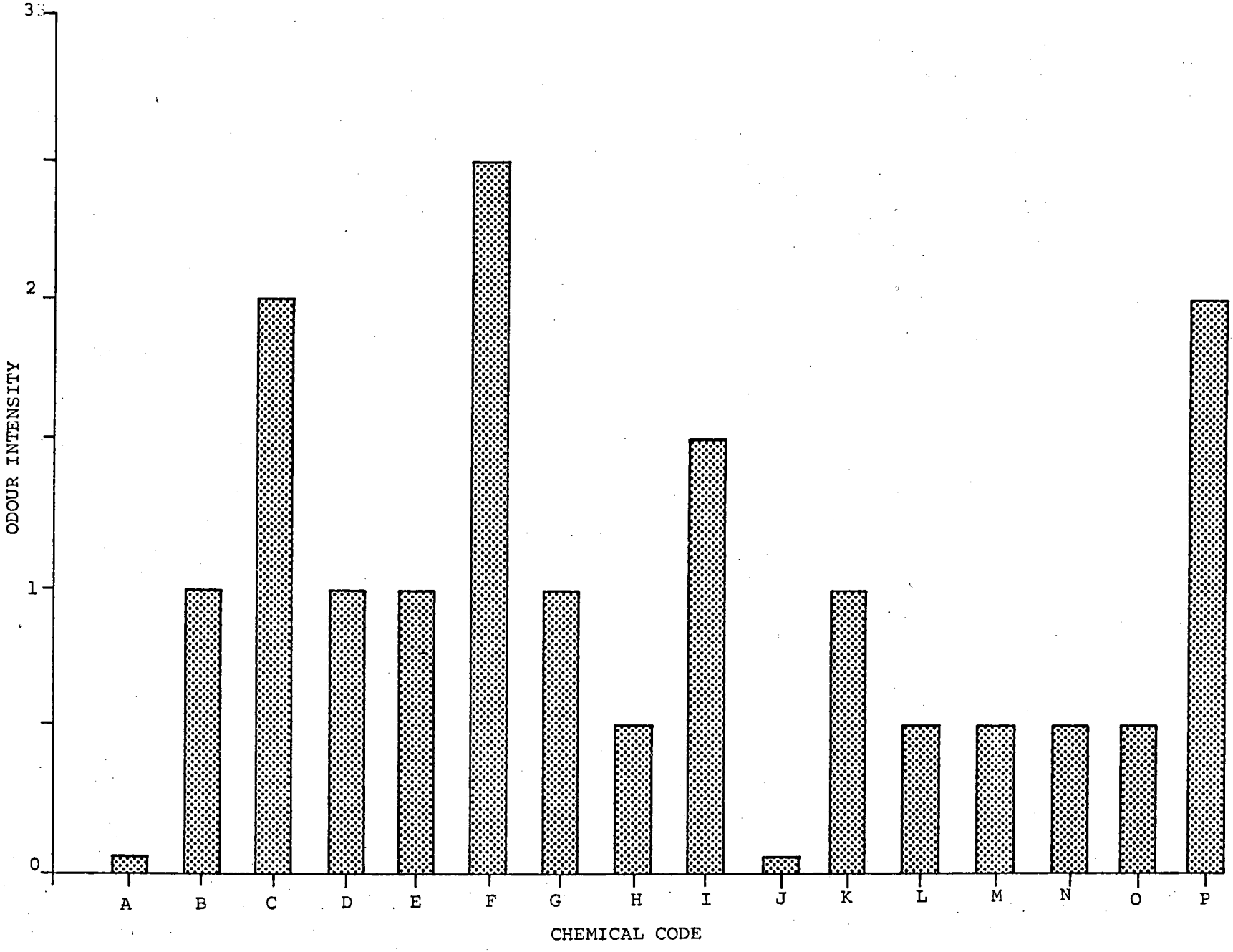

FIGURE 30

RELATIVE SEWAGE ODOUR AT 50% OF RECOMMENDED CHEMICAL DOSAGE

Low Urine Sample; 14 days Contact Time

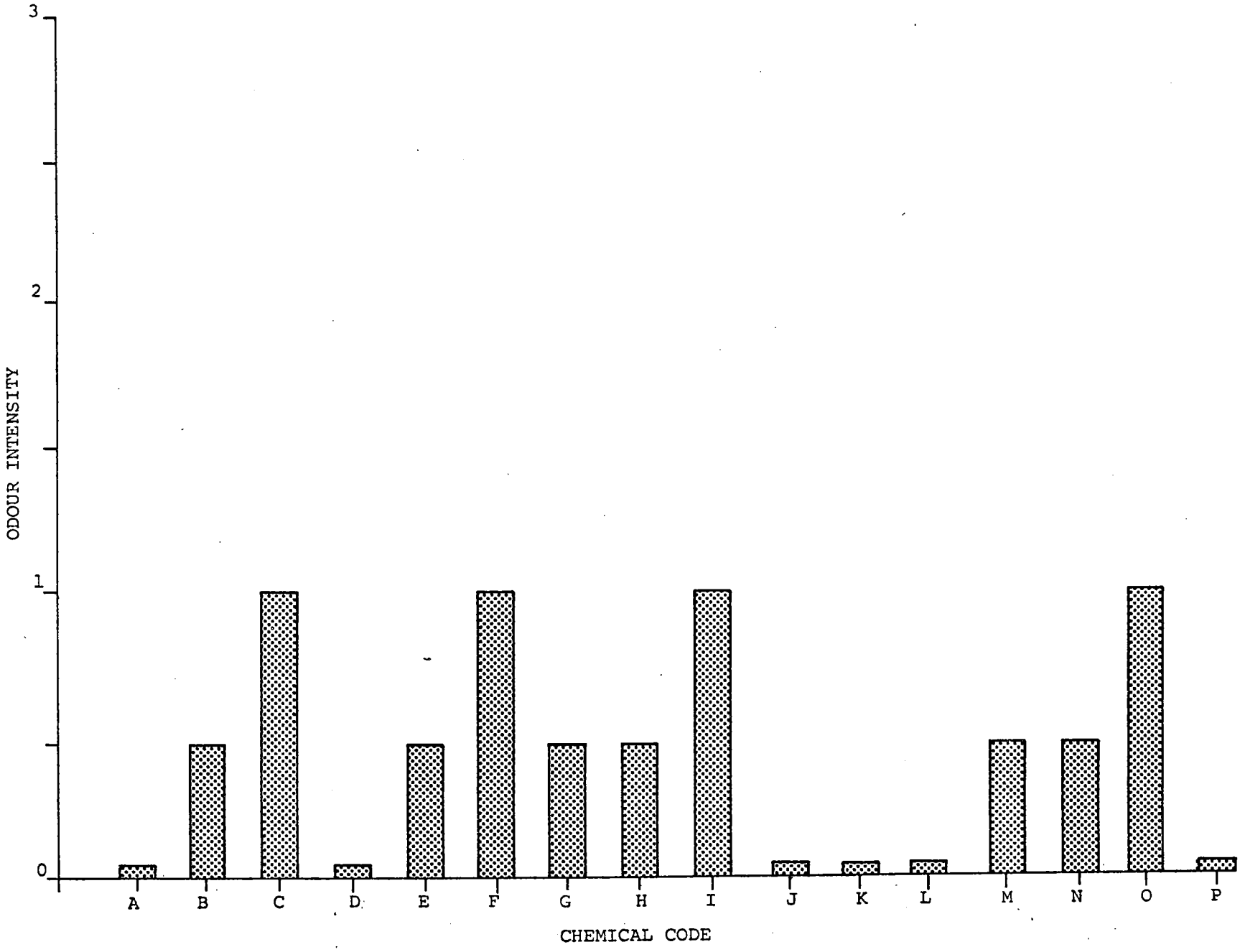

FIGURE 31

RELATIVE SEWAGE ODOUR AT 50% OF RECOMMENDED CHEMICAL DOSAGE
High Urine Sample; 4 hour Contact Time

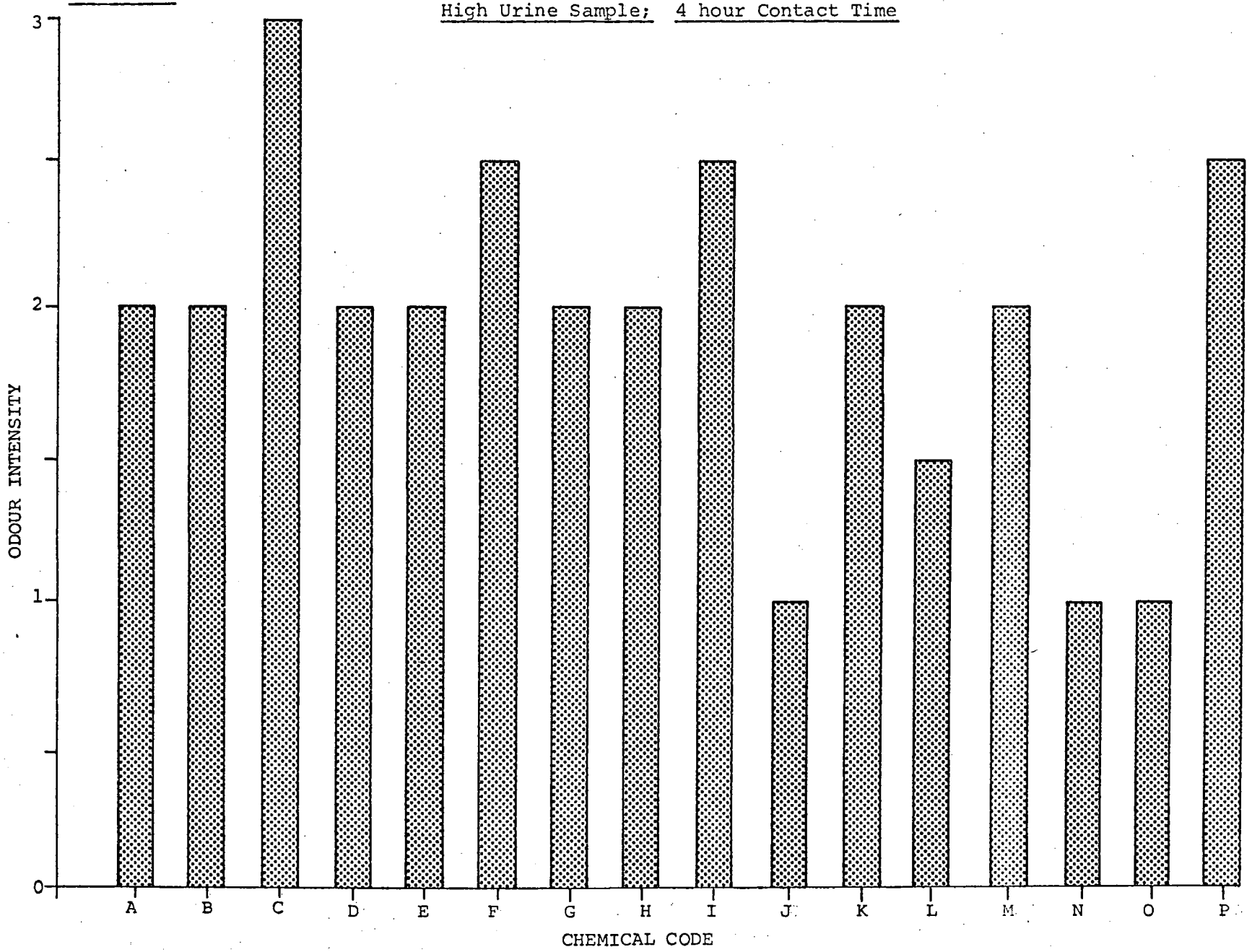

FIGURE 32 RELATIVE SEWAGE ODOUR AT 50% OF RECOMMENDED CHEMICAL DOSAGE

High Urine Sample; 14 days Contact Time

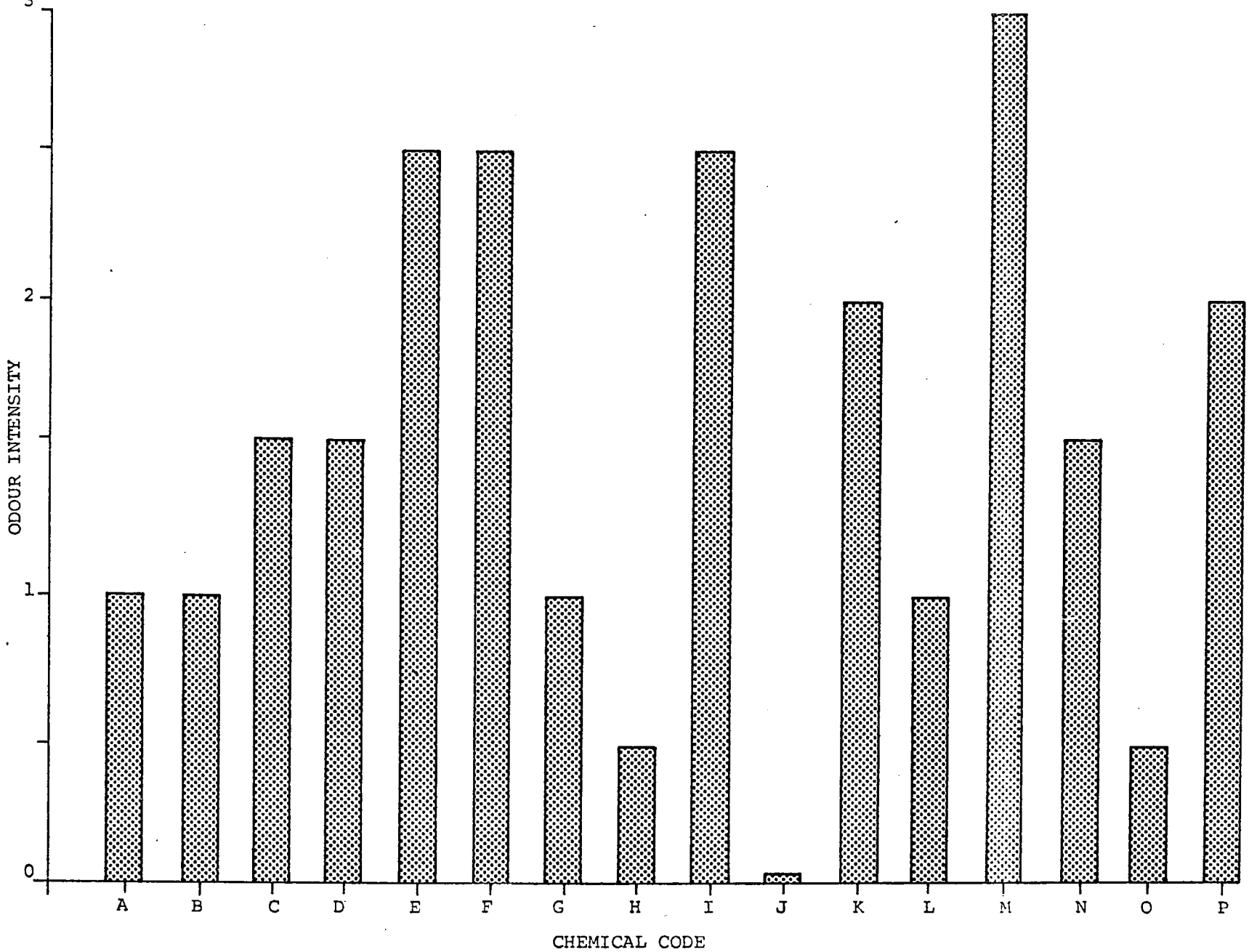

FIGURE 33 EFFECT OF ODOUR CONTROL CHEMICALS ON ACTIVATED SLUDGE

1% of Recommended Dosage

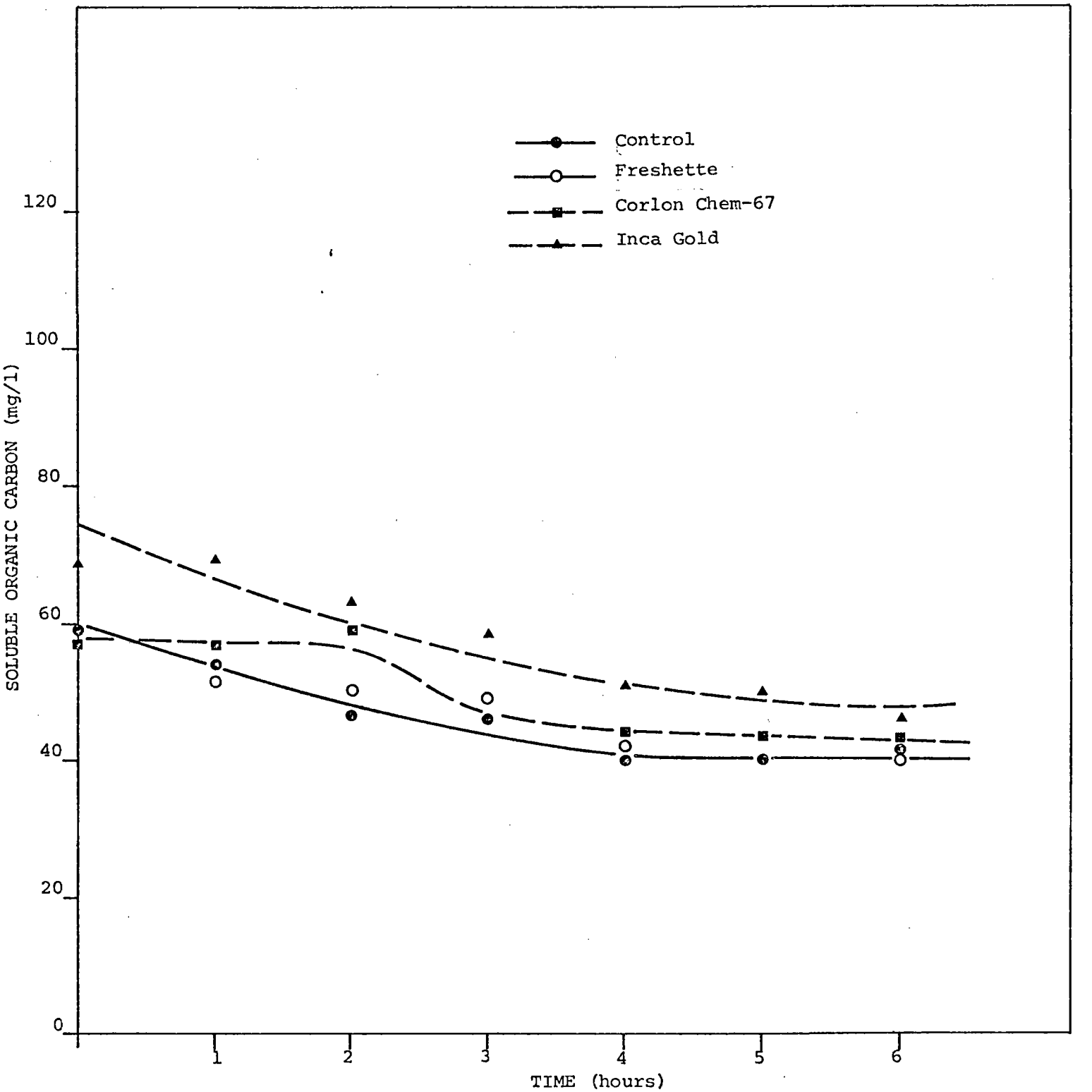

FIGURE 34 EFFECT OF ODOUR CONTROL CHEMICALS ON ACTIVATED SLUDGE

10% of Recommended Dosage

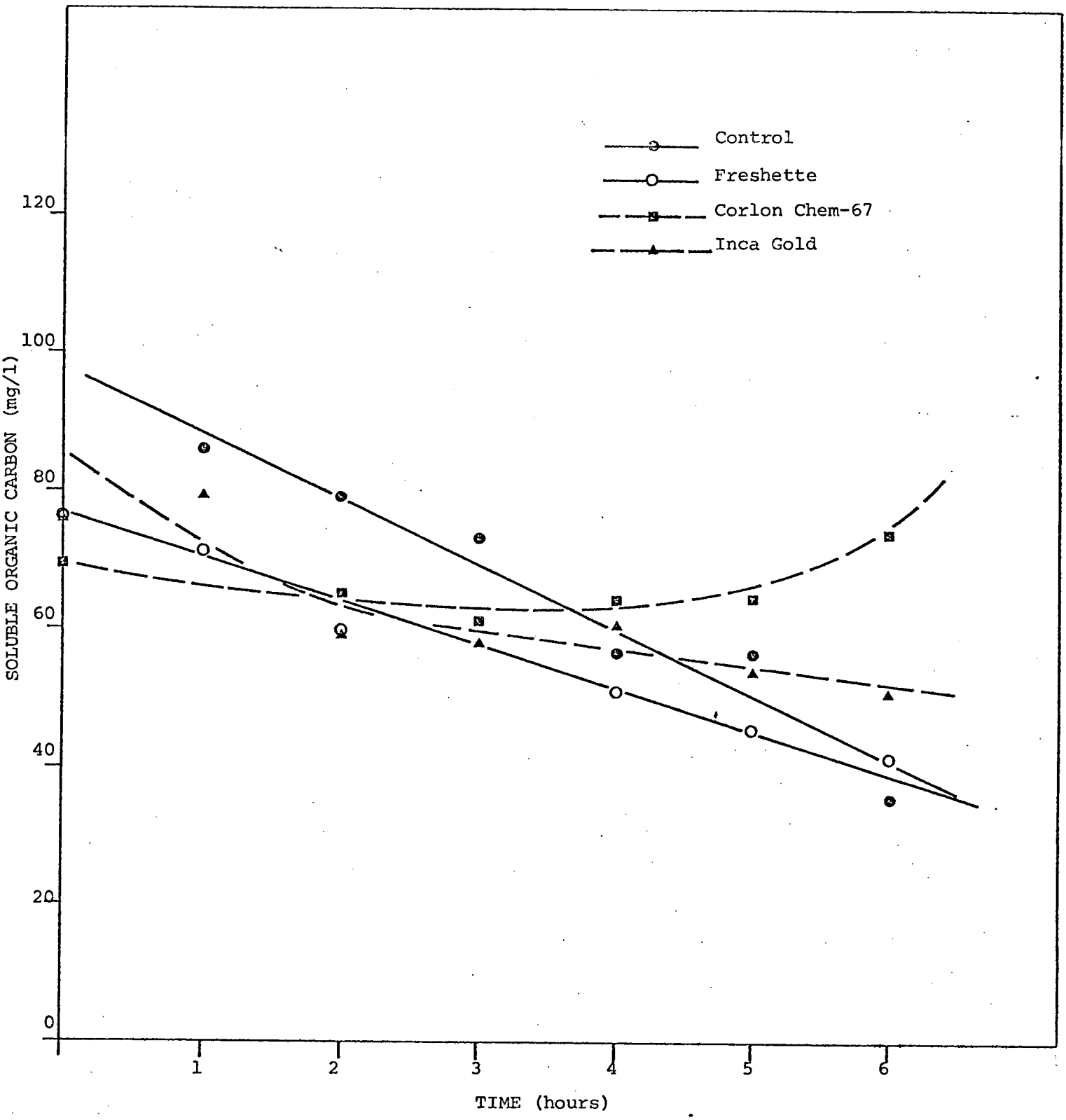

FIGURE 35 EFFECT OF ODOUR CONTROL CHEMICALS ON ACTIVATED SLUDGE

50% of Recommended Dosage