

韓國의 農村地域에 있어 固形廢棄物 處理系統의 設計

Design of Solid Waste Management Systems in Rural Areas Korea

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要 約

每年 韓國內에서는 不適切한 方法 또는 不法의 無差別하게 음식찌꺼기 및 쓰레기와 農業 쓰레기 등이 합부로 버려짐으로써 이들 廢棄物은 數百萬屯에 달하고있어 國民들의 健康上 큰 被害를 주고 있음은 勿論 社會的 經濟的인 側面에서 莫重한 負擔을 안겨주는 現實的인 環境保全 問題로 대두되고 있는 實情이다.

本稿에서 紹介코져 하는바는 農村 地域社會에 있어서의 系統 解析에 依한 體系의인 廢棄物 處理對策을 樹立하던 害虫과 保菌生物의 棲息處로 부터 農村地域을 保護할수 있고 水質 汚染防止에 크게 이바지할 수 있을뿐만 아니라 國家의 社會的 經濟的 收益增大에 對한 警覺心을 일깨워 줌으로서 地域社會에서 傳統의으로 惰性化된 自然保護에 關한 無關心을 打破하는데 하나의 커다란 契機가 될수있을 것으로 본다. 그리고 中央및 地方의 行政機關과 有關機關들은 以上의 所期目的을 達成하기 爲하여 많은 努力과 技術의 支援을 傾注하여야 할 것이다. 한편 廢棄物의 貯藏, 蒐集, 運搬과 處理過程은 相互間 不可分의 聯關性 있는 系統을 이루어야 하며 廢棄物處理에 앞서 事前에 充分히 熟考하여야 할 點은 美觀上은 勿論 衛生上의 問題를 惹起하는 널리 散在된 많은 쓰레기場의 整理에 依하여 傳染病媒介體(쥐, 파리, 모기등)및 病原性細菌의 廣範圍한 繁殖을 防止할 수 있다는 것이다. 이러한 叙上의 對策으로서 地理的 社會的 및 經濟的인 側面에서 우리의 類似한 美國의 西버지니아 農村地域外 몇개 地域의 事例를 들어 地域社會의 效率性있는 廢棄物處理系統을 紹介하고자 한다.

Introduction

In 1977, approximately 5 million tons of solid wastes were collected and disposed of in the Republic of Korea by private and public agencies, costing approximately ₩13 billion. The reported cost does not include equipment depreciation or interest on the investment. Possibly another ₩2 billion was spent by industry and another ₩1 billion was spent

for operating costs, capital spending, and upgrading disposal sites and facilities. How much of this waste was disposed of properly and how much was spent on improper disposal is a matter of conjecture since the matter of defining "proper" seems to depend on whether the person doing the defining is a collector, disposer, or regulatory agency.

The referenced 5 million tons is approximately 1/3 of the total tonnage produced in Korea, based on 1.2kg/cap/day, as determined

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by Rhee and Choi 16). Thus, there appears to be an uncollected 10 million tons each year 5). This figure should be quite conservative, considering agricultural wastes, which are not included here, may comprise well over 50% of the solid wastes produced in Korea.

Agricultural wastes in Korea are disposed of by burning for farmhouse heating and cooking, by grinding for animal feed and fodder, and by composting. How much is reduced to ash by open burning in the field at harvest time is not accounted for here. The former use of rice straw for roofing rural buildings was a fire hazard and a haven for pests and vectors, but did offer a fourth method of rice straw use. The replaced straw roof, however, still had to be disposed of.

Financing

Urban collection and disposal systems normally can be financially supported by local and municipal budgeting schemes, although solid waste management specialists recognize that the municipal solid waste (or "garbage") department often must subsist on the leftovers from political, economic, and social trade-offs that take place within local government. As a result, many of these solid waste management systems may be in need of extensive revamping, especially those that just grew without adequate technical input or expert modeling.

Rural collection and disposal systems are much more complex and presumably more costly since the homes and other collection points are more dispersed. This increase in travel time adds to the annual costs of vehicular operation and maintenance and increased sitting time for the driver and helper.

The problem in the rural area is similar to

that in the urban area: provide, at minimum cost and maximum worker safety, for the PROPER storage, collection, hauling, and disposal of solid wastes. The major parameters are also the same—time, equipment, land, and personnel—all adding up to won. Improved aesthetics and other social benefits can be used to maximize cost effectiveness.

The values associated with these parameters are different, however. Time is usually less costly or otherwise as important in the rural area than in urbia; equipment purchase may vary either way, depending on the size of the area involved and the type of disposal equipment selected; land is much less expensive in the rural areas; and personnel costs in the rural setting are usually less expensive in terms of unit time, but are more costly in terms of production units, which is a more realistic judgement criterion. In rural areas, personnel turnover is costly in terms of equipment damage and costs associated with inexperience and the training of new personnel 3). The reasons for the cost differences in other parameters are implicit and will not be dealt with further here.

Institution of A Solid Waste Disposal System

Inertia is a fundamental law identified and scientifically described by Sir Isaac Newton. Every process-- technical, social, or economic --must have an initial force to set it in motion. A solid waste management system is just another process that must contend with the problem of inertia.

Most knowledgeable citizens desire acceptable methods and locations to dispose of their solid wastes, but small communities usually lack the organization and funds to implement solid waste collection and disposal systems.

These two elements--organization and funds--are synergistic and coquiescing; a community would have much difficulty organizing for a solid waste management system without funds, and funds cannot be made available to a community without an organization to receive them.

Municipalities have short-term and long term goals from which they estimate budget requests to submit to their funding sources for implementing goal-achieving procedures. The rural community, however, must organize within itself or seek assistance from existing agencies which have operating funds.

Local, provincial, and national agencies do have access to national funds but they also have priorities. These agencies can assist in many other ways, however, to overcome inertia, assist in developing programs, locate funds, and, in many cases, provide expertise in planning, designing, and operating solid waste management systems.

Community leaders can seek advice and technical assistance at the local level from the local or city departments of social welfare or the city cleaning department. At the provincial level, the Office of Sanitary Engineering in Chungnam Province's Department of Social Welfare has been helpful in researching data for this paper 21). The Office of Environment in the Korean Ministry of Health and Social Affairs, which also provided information for this paper, has many experts willing to assist community leaders and practicing solid wastes management engineers at the National level.

Probably the most difficult task in rural solid waste management is overcoming the inertia. Someone has to sow the seed-- bring the problem of solid waste in the area to the attention of the local, provincial, or national health agency, any of the ministers involved

with environmental protection, or one of the assistance agencies identified above. Most are genuinely interested in providing some sort of assistance. A cold shoulder from one agency should pose no real problem; another agency is just across the hall or down the street. As public agencies, their mission and responsibility is to serve the public and protect its health 9, 18).

Storage

The laws and regulations concerning the proper storage of solid wastes are concerned mostly with container size, weight, construction, composition, covering, and placing. Assume, for the sake of argument, that these laws and regulations are fully enforced.

The decision-makers for the rural system can evaluate from six major alternatives:

- a) 100-liter containers at each collection site
- b) 4-6 cu. meter rural containers(green boxes)
- c) combinations of a) and b) appropriate to the haul route and housing density
- d) combine a) with large(10-20 cu. meter) depositories
- e) combine b) with large depositories
- f) combine c) with large depositories

The collection site in a), above, could be the individual home, a central location in the village, or a central location in the local population area.

Optimization techniques 12) considering haul routing, extent of area to be covered, and volume of refuse to be handled should be employed to determine site locations for containers and/or depositories. Monte Carlo and paired comparison analyses 6, 15) are useful tools for initial evaluation and direction towards the final decision.

Collection and Hauling

The most important requirement to be considered in selecting the collection equipment is that it be able to do the job it will be called upon to do. Load volume and weight, operator capability, type of terrain, and climate are some of the constraints to be carefully identified and described. The first two items are controllable but the last two are not, although the type of terrain may be localized by route when the routing areas are identified. Again Monte Carlo and paired comparison techniques can be quite useful. Collection frequency should be on the order of twice weekly or less, primarily for fly progeneration control 2).

Disposal

Selection of disposal location and type is probably the most difficult decision to make in solid waste management 11). Aside from the problems of determining the most sound investment route, e.g., compost, incinerator, sanitary landfill, or other, the decision maker must bear up under the cacaphony of complaints 14) from politicians, landowners, homeowners, contractors and environmentalists, all of whom have suddenly become experts in solid waste disposal, each for his own reason.

The decision as to the type of disposal facility should be made only after due consultation with professionals knowledgeable in the fields of soils, geology, land use and planning, rheology, hydrology, roadway design, and civil engineering design, as well as the local leaders and public administrators. It definitely should not be made following a mere community leader-salesman interaction.

Economic gains possible through recycling should be evaluated 19) when considering disposal location and method, even though present trends continue to show that attitudes toward recycling continues to wane and per capita consumption continues to gain, in turn increasing the per capita production of solid wastes.

Associated Rural Problems

The preceding introductory paragraphs were intentionally cursory, as most professionals in the field can handle the systems analysis and decision-making process --usually with some type of model based on adequate reliable facts and data pertinent to the region under consideration. However, the importance of the interrelationships is not always fully recognized. For instance, during the selection of the disposal facility, the decision-maker sometimes fails to fully consider the post hoc needs and development of the site selected. A change in type of disposal facility may require an alteration in the storage and/or collection equipment, which in turn may relocate storage equipment which may call for revision of the hauling routes which may further change the equipment specifications.

Oftentimes too many parameters are omitted from the structural model on the assumption they are insignificant when in fact they may alter the model significantly. One parameter that is often neglected during the start-up phase of a rural collection system is the effective closing of the existing areal open dumps. This relatively inexpensive necessity for health and aesthetic reasons is even more often neglected when preparing the budget for the implementation year.

Proper dump closure plans should be tri-

directional and correlative. The three activity functions are engineering, education, and elimination, all operated under a closely supervised, correlated, dynamic model as shown in Fig. 1. The major activities associated with the three activity functions are outlined in Table-1. Most of the items in Table-1 are self-explanatory; only a few need further discussion. Under ENGINEERING, cover material often poses more of a problem than one would expect 19).

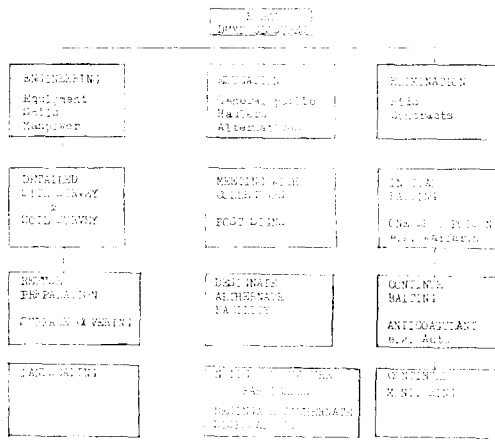


Fig. 1. Rural Pump Closure Activities

Table-1. Three-Prong Functions

ENGINEERING

- Activity manager
- Consolidation of refuse
- Compaction of refuse
- Cover material
- Drainage
- Final grading
- Revegetation
- Soil stabilization
- Fire extinguishing
- Access barriers
- Scavenging
- Maintenance
- Phasing of dumps closure sequence
- Removal of waste

EDUCATION

Signs

- closure
- nearest disposal site
- rodenticides

News media releases

- closure date
- danger of rodenticides
- first aid and emergency treatment
- enforcement

Other agencies

- cooperation
- input

ELIMINATION

- Licensed Pest Control Operator(PCO)
- Legal rodenticide
- Contract
- Training of existing personnel
- Continued monitoring

Hauling for dump covering may be expensive. Should nearby cover material be unsuitable for supporting revegetation, removal of the waste material to a more suitable site or to the area disposal facility may be more in order. Barriers across the former access to the dump must be installed sturdily to minimize continued illegal dumping at the site. Posts, chains, cables, and earth berms are successful reminders that the dump has been closed. Assignment, or at least designation, of responsibility to prevent scavenging and to assure continued maintenance of the improved site is obviously important but is usually delayed until sometimes too late.

Under EDUCATION, sign posting must be tended to as early as possible in order to be able to notify dump users of the closing of the dump well in advance of the actual closing. The sign should also state the distance and direction to the nearest approved disposal site and the type of rodenticide and its associated dangers to children and pets.

News releases through the radio, TV, and newspapers are often more effective if issued by a well known, responsible local, provincial, or national official, group, or agency. The news information should also identify the agencies which will be cooperating in the dump closure activities and which will have other input such as the enforcement of the existing laws and regulations.

The elimination of rodents, dogs, and other pests at the closed sites should preferably be done by a licensed pest control operator for reasons of liability and expertise, should be done by contract stating the type and amount of rodenticide to be used and length of guarantee, and should be done with taste and tact. The pest control agency normally has ready-made signs available for use at the site and for distribution throughout the community.

These three components of rural dump closure should be closely controlled with respect to time through the use of tools such as PERT. However, in no case should a rural dump be closed without first implementing alternative waste disposal sites that are available to the waste producers. Indiscriminate rural dumping cannot be controlled or corrected by simply erecting a barrier across the access to the dump that has been used by the neighborhood for individual or community waste disposal. The lock-chain technique will result in rodent migration and increased rural littering.

The public will rightly rise in force if it is not kept informed of the disposal sites and systems under consideration, expected annual costs, location of rural containers or depositories, cost/benefit and cost/effectiveness values and actually has a say during the planning stage 8).

These residents should be informed and

have a say. After all, it's their money and their neighborhood.

A Case in Point

A southern county in West Virginia had a rural solid waste disposal problem. Indiscriminant littering of field and stream and conspicuous open dumping was indeed an eyesore. Concerned citizens brought the problem to the attention of the county board of health which in turn requested professional assistance from the state department of health and from a regional health demonstration program. The regional program investigated the problem, surveyed dump sites and reported estimated costs to the board of health. A time-phased plan was developed to coincide with the establishment of a regional sanitary landfill and rural container system.

Funds were requested from the county court, the state department of highways (since this system would relieve the department of highways of some of their solid waste problems), the Appalachian Regional Commission, and the county board of health, itself.

Alternative dump sites were located on a map, and routing, container size, and equipment requirements were determined. Estimated costs for reclamation or removal of the dumps averaged ₩300 per cubic meter of waste material in the open dumps. The costs included reclamation seeding or other vegetation, rodenticides, installation of access barriers and/or removal of the solid wastes from the open dumps to be closed.

Many rural communities of 10—20 homes within a 1500 meter radius petitioned to have rural containers located in their communities and guaranteed to purchase the container outright if the collector would collect from

it on a regularly scheduled basis.

Local residents were the instigators to overcome the inertia, the county board of health was the pursuer, a regional program provided the expertise and public informatoin program, and the county court and the ARC provided the funds.

Conclusion

West Virginia, the site of the case in point, is quite similar to southern Korea, with its low, rolling mountains and narrow plains, agricultural and mining economy, and growing pains. The residents of West Virginia, mostly of low income, recognized the benefits that would be accrued from tourist income and their own better health, once aesthetics improved and rodent, insect, and other vector habitats were removed. The excellent attitude in Korean nationals towards cleanliness and order is obvious and commendable. Rural solid waste management in Korea can be an effective force in improving the health, social, and economic aspects of national development through dynamic engineering programming.

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우리의 用役業務는 좀더 簡素化될 수 없을까?

인도네시아 데콥라다 2단계

용역단장 金 斗 植

團長이란 莫重한 責任을 지고 일한지가 벌써 4個月째 되었다. 앞으로 더 約 20個月의 무거운 짐을 지고 가야한다. 그동안 20餘名의 團員들과 더불어 2個地區中 1個地區의 妥當性 調查報告書가 完成段階에 들어갔다. 團員들은 主로 農業振興公社職員과 스위스인으로 構成되었지만 中 스위스로 轉換한 오스트리아, 체코슬라바키아, 폴란드, 독일인등 각 1명씩 끼어있다. 그러면 왜 그네들은 世界에서 國民所得이 第一 높다고 UN 統計에서 報告되었을까? 用役業務 遂行 側面에서 느낀 點을 紹介코저 한다.

우선 報告事項에 對하여 그네들은 極 簡素化되었다. 例를 들면 우리 農業振興公社는 每月末日이면 建設輸出現況 綜合報告書作成이 2日, 기타 報告書가 4日, 또 分期末日이면 進捗출현황종합 보고서작성이 2日, 國內 內資精算書 및 다음 分期經費申請書作成이 4日, 外資申請 및 精算書作成이 4日, 大使館 確認 2日等 最小 12日이 걸린다. 그러면 스위스인은 어떤가 단 하루도 안걸린다. 그만큼 그네들은 時間的으로 餘裕가 있고 餘裕있는 時間을 自己 專門分野에 利用한다. 다시 말해서 그네들은 本社에서 現地파견된 團員을 100% 믿는다는 意味도 있다.

모든 費用이 적힌 Card 2枚만 本社로 부치면 끝난다. 勿論確認을 위하여 團長인 나에게 確認싸인을 받는다. 그들은 一切 領收證을 別途로 가지고 있는지는 몰라도 本社 會計報告에는 첨부하지 않고 단 2枚로 끝난다. 大使館의 確認도 必要없어 참으로 부러운 일이다.

우리의 일이 소소한 일 같지만 1명의 團員이 그만큼 時間的으로 自己分野에 業務를 못하게 되어 고 말프기 짝이없고 全體的으로 業務推進에 큰 支障을 주고 있다. 百餘名의 團員 및 政府職員을 對하는 데 겨우 몇분되지 않는 業務推進費에 일일이 領收證을 붙여야 옳은지, 個人國民所得이 US\$ 12,000인 스위스인을 쫓아가려면 우리도 좀 생각해 볼 여지가 있지 않나 생각된다.