Production of crushed rock aggregate: Some environmental considerations

T.F. NG[1] & E.B. YEAP[2]

[1]Institute of Advanced Studies, University of Malaya
[2]Department of Geology, University of Malaya

Introduction — Rock aggregate is important to national development and deserve serious consideration. Rock aggregate and related construction materials are essential in the construction industry and public works. Adequate supply of these materials is necessary to sustain the growth of a nation, the nation's prosperity and quality of life.

In response to rapid development and urbanisation of our country, the aggregate industry represents one of the large scale extractive industry. The establishment of large quarrying operations attract controversy as they pose negative impacts to the environment. Quarrying is often resented by nearby residents as it may cause direct and indirect impact, nuisance and hazards to their well being, as well as damages to the environment, property, crops and livestock.

The most common environmental objections to quarries are related to visual impact, air and water

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pollution, noise, ground vibration, air blast and flyrock occurrences. Most of these temporary environmental impacts should be assessed, quantified and reduced to acceptable levels by careful location, design and operation of the quarries, as well as early mitigation measures. Quarrying also causes permanent scarring of the landscape.

Visual intrusion — In developed countries where there is a greater awareness of environmental issues, widespread adverse reaction to the appearance of quarries and mines are noted. However, in Malaysia complaints about the visual impact of quarries and mines are generally unheard of. There is no legislation pertaining to visual impact of quarries and other development projects, although landscaping is advocated as part of quarry restoration upon closure of the quarries.

The most notable visual impact of quarry and its associated facilities are bare steep rock faces or pits which are highly visible due to its visual contrast with the surrounding vegetated areas and skyline. Quarry facilities such as crushing, conveying and screening equipment, machinery sheds and stockpiles are also visually unattractive. Pollutants such as airborne particles may be seen far away.

Air pollution — Air pollution in the form of airborne particulates or dust is one of the main environmental problem in many quarries. Emission of other air pollutants such as carbon monoxide, hydrocarbons, sulphur and nitrogen oxides are often relatively low. Dust problems are particularly severe in dry and windy conditions. The Department of Environment records shows that 3 to 7 percent of all air pollution complaints made by the public are directed at rock quarries. In the year 1992 and 1993 respectively, only 75.8 and 84.5 percent of the quarries in Malaysia complied with the Environmental Quality (Clean Air) Regulation 1978.

Airborne particulates can be categorised into 2 groups: those less than 10 microns in diameter (PM_{10}) which is often considered to be respirable; and those coarser which is non-respirable. Respirable particle hazardous to health and the non-respirable dust is considered a nuisance. These particles can also damage crops and other vegetation. Airborne dust in granite, quartzite and other quartz-bearing rock quarries contain high levels of silica, hence quarry worker and residents living close to the quarries are at risk of developing pneumoconiosis. Studies on workers of government granite quarries in seven Malaysian states in 1978 show that 25 percent of the quarry workers had silicosis and 8 percent had suspected silicosis. To control dust exposures, the Factory and Machinery (Mineral Dust) Regulation 1989 came into force.

The principal sources of dust in the quarry are related to comminution processes (crusher, drilling, blasting), screening, traffic movements, conveying and dumping of aggregate into the hopper and stockpiles. Wind erosion of non-vegetated areas also produce dust.

Water pollution — Siltation can be a serious problem in quarries if appropriate mitigation measures are not taken, particularly during land clearing, site preparation and the early stage of quarry operation. The silt-laden rain water run-off discharged into nearby streams will cause an increase in the suspended solids concentration and turbidity of the stream water. The main effect of siltation is the deterioration of water quality, making the water unfit or less suitable for consumption or industrial use. Siltation also causes ecological damages by reducing the biodiversity of aquatic life.

In the production aggregate, hazardous chemical compounds are rarely use, and thus there will be no introduction of significant concentrations of substances that cause physical and/or chemical changes to the groundwater and surface water. However, water can be polluted by accidental spillage, leakage or discharge of liquid fuel and oil from machinery.

Noise — Noise is often considered a nuisance to the public, and may cause permanent or temporary hearing impairment to quarry workers. The main sources of noise in the quarries are from traffic movements, processing equipment (crusher, screens, conveyor, etc.), drilling and blasting. Presently, there is no enforced regulation on the level of noise generated in quarries that affect the public, although the level of noise the quarry workers are exposed to is governed by the Factories and Machinery (Noise Exposure) Regulation, 1989.

Blasting — Complaints of damage and nuisance due to blasting are common whenever a quarry is located close to residential, commercial and industrial areas. The main problems related to blasting are ground vibration, air blast and the occurrence of flyrocks. All three have damaging effects on buildings, however the effects of ground vibration is more severe over a larger area. Ground vibration also causes physical discomfort to surrounding residents, and flyrocks pose a safety hazard to quarry workers.

Transport — Like all other industry, the aggregate industry requires two-way flow of materials, personnel and products with the external communities. In Malaysia, a great majority of the aggregate is delivered by trucks (road transport), though railroad and water transport also exist. The vehicular traffic, particularly trucks used to distribute rock aggregate has become a source of nuisance and a safety hazard. The main impacts of vehicular traffic are public safety, noise and vibration, air pollution and interference of these traffic with private traffic.

Biological impact — Quarry operations will inevitably cause negative impacts to flora and fauna. The extent of impacts is influenced by the natural condition of the site prior to development (such as topography, abundance and number of species, habitat type, ecology, conservation status), and scale and mode of quarry operation. Development of quarries may cause loss (partial or total) of forested areas and plant/wildlife habitats, loss of flora and fauna (especially rare or endangered species) and reduction in biodiversity.

Reclamation — Quarrying is only a temporary use of land, and the quarry operators are obliged to reclaim the working sites upon exhaustion of the rock materials to a condition suitable for some use. Abandoned quarries can be reclaimed into residential, commercial and industrial site, recreation areas, agriculture land, landfills, and others, dependent on the configuration, topography and hydrogeology of the abandoned site. To reduce the cost and problems related to reclamation, rock extraction and disposal of quarry waste should be made with the final landscape in mind, and reclamation works should be made parallel with rock extraction.
