4 Water-dispersible granules

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4.1 Introduction

Agrochemical water-dispersible or soluble granules (WG) have been on sale since the 1960s ([1] [2]; ‘Weedol’ was an established product when the first edition of [3] was published). ‘Weedol’ and ‘Pathclear’ formulations, for example, are household names in the UK, having been available to the general public for over 30 years. It is a common occurrence however, at conferences and symposia, to find water-dispersible granule formulations being classified as novel. This may be a consequence of the relatively low percentage of the market historically taken by the WG formulations. Despite this there are in fact hundreds of WG formulations currently commercially available, covering a very diverse range of chemistries and physical forms of active ingredient (survey carried out by S. M. Critchley for Zeneca Agrochemicals plc, 1994).

In recent years WG formulations have taken an increasing share of the agrochemical marketplace (paper on Trends in pesticide formulation presented by B. Frei at Formulation Forum #94, Washington, 1994). Estimates vary as to the actual size, which seems to be about 10%. This represents a very sharp rise compared to a few years ago, and it is clear that the current climate of safety and environmental concern has been the driving force.

The rise of importance of the WG as a physical form can be seen by examining the published patent literature in the area (Figure 4.1; unpublished patent database results collected over several years to 1996 by G. A. Bell for Zeneca Agrochemicals plc). Clearly there was a step change in the rate of production of patent applications in about 1990, which implies there was a decision to work in this area at some time in the middle of the 1980s. Further evidence to back this up comes from the number of new products launched between 1990 and 1994. Arguments over package disposal, operator safety and waste limitation have been going on for many years. However it may have been at that time that the economics of green formulations really became apparent.

Prior to that time the number of WG formulations commercially available was quite low. The added cost of manufacture may have been part of the reason for this, however, and another major factor, one which is common to all formulation types, would have been the suitability of the available active ingredients.
Many of the early water-dispersible granules contained actives which had high melting points and low water solubilities, for example atrazine, as these were relatively easy to formulate. The absence of a solvent such as water was a key aspect of the formulation type and led to the inclusion of some other types of active ingredient (AI). Highly water-soluble materials were usually sold as simple solutions (SL), whereas those materials which did not dissolve in water became emulsion concentrates (EC) or perhaps suspension concentrates (SC). The obvious niche for WG formulations was to deal with those AIs which had low solubility in both water and organic solvents. Pirimicarb is a good example, having a water solubility of 3 g/l, and would therefore have been uneconomical as an SL. Its solubility in organic solvents was also rather low, so an EC was of limited use. As an SC its solubility tended to give rise to crystal growth, so the obvious answer was granulation (Aphox 50 WG is manufactured and sold by Zeneca Agrochemicals; the first reference to this product is believed to be [4].)

Arguments such as these are still valid. However, nowadays there is a greater willingness to tackle difficult problems, and the result has been that the variety of active ingredient types which are formulated has grown. Materials which would previously have been sold as liquid formulations are now available as solids and the result is that the marketplace can be broken up into different types of WG, depending on the active ingredient physical form (Table 4.1).

The expansion of the basic formulation to be able to cope with more difficult active ingredients has created other opportunities which are likely to be exploited in the near future. The increase in patenting activity in the