Effects of Cover Soil Thickness on Revegetation of Acidic Appalachian Coal Refuse

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Revegetation Issues

- Very few coal refuse disposal facilities have stored sufficient topsoil or suitable spoil materials to cover these piles for revegetation.
- Current federal and state regulations allow direct seeding, but only with sufficient proof of concept and appropriate testing of the refuse materials.

Original Research Objectives

- **To evaluate the minimal topsoil depth necessary for the successful reclamation of acid-forming coal refuse materials.**
- **To determine the effect of lime additions to the refuse/topsoil contact zone upon minimal topsoil depth requirements for successful reclamation of coal waste piles.**

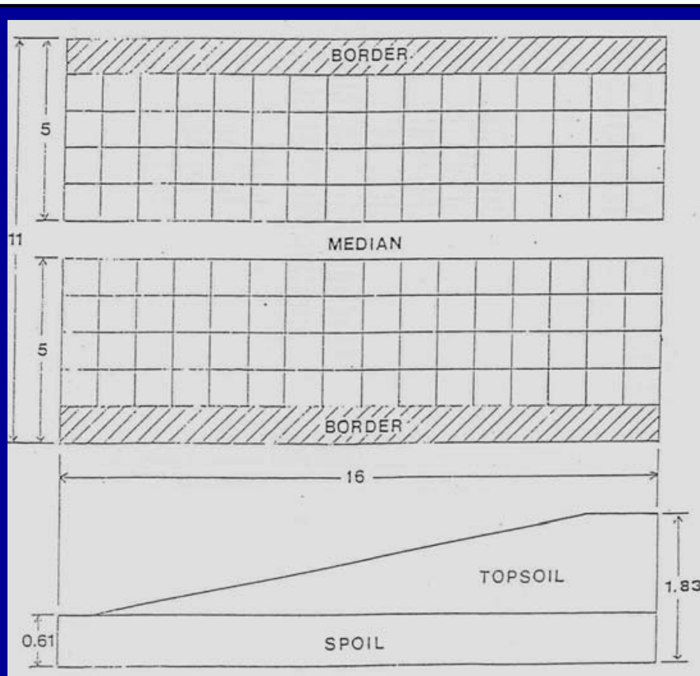


Table 1. Percent ground cover at JSR in September 1987. Mean values for limed vegetation followed by a * are significantly different than their corresponding un-limed depth class.

	Topsoil Depth (cm)					
	0	15	30	60	90	120
	------------------% Cover ------------------------------------					
Lime	25.0*	92.5*	95.0	92.5	95.0	100
No Lime	5.0	62.5	97.5	97.5	92.5	97.5

Table 2. Percent ground cover in August 1987 at BMR. Mean values for limed vegetation followed by a * are significantly different than their corresponding un-limed depth class.

	Topsoil Depth (cm)					
	0	15	30	60	90	120
	---------------------% Cover ------------------------					
Lime	55.0*	62.5*	75.0	82.5	85.0	95.0
No Lime	37.5	47.5	85.0	65.0	90.0	77.5

Topsoil thickness trials being installed in Wise Co. Soil cover was varied from 0 to 1 m with and without 25 Mg/ha lime at contact.

Table 3. Percent ground cover in September 1986 at RRA. Mean values for limed vegetation followed by a * are significantly different than their corresponding un-limed depth class.

		Topsoil Depth (cm)					
	Aspect	0	15	30	60	90	120
		-------------------------------------% Cover-----------------------------------					
Lime	South	90.0*	97.5*	100	97.5*	97.5	97.5
No	South	77.5	82.5	90.0	62.5	92.5	82.5
Lime	North	62.5	67.5*	35.0	45.0	85.0	85.0
No	North	62.5	32.5	42.5	50.0	77.5	87.5
Lime	East	80.0	62.5	57.5	65.0	72.5	87.5
No	East	67.5	72.5	70.0	82.5	75.0	95.0
Lime	West	75.0	82.5	82.5	82.5	85.0	92.5
No	West	80.0	75.0	85.0	92.5	77.5	92.5

Table 4. Mean percent ground cover versus topsoil depth across all wedges at RRA in September 1987. Mean values for limed vegetation followed by a * are significantly different than their corresponding un-limed depth class.

	Topsoil Depth (cm)					
	0	15	30	60	90	120
	--------------------% Cover --------------------------					
Lime	76.9	77.8	68.7	72.2	85.0	90.6
No Lime	71.9	65.6	71.8	71.9	80.6	90.0

After two years, trenches were ripped up the limed and non-limed sides of each wedge to observe rooting vs. subsoil properties.

Note very limited growth on bare waste, but rapid increase in cover and vigor with very limited (15 cm) soil covers with lime at soil/refuse contact.

Potential acidity by acid-base accounting (ABA)	Lime recommendation	Amendments and seeding strategies
<20 Mg ha^{-1} net acid	Lime to ABA need	Direct-seed with heavy P, straw mulch, and organic§ amendments if possible. Use refuse seed mixture.
20–50 Mg ha^{-1} net acid	Lime to ABA, split if necessary	Direct-seed with heavy P, straw mulch, and organic§ amendment (required). Use refuse seed mixture.
50–100 Mg ha^{-1} net acid	Add lime (ABA need) at refuse-soil contact	Topsoil cover with 15–30 cm of final depth. Use conventional lime, fertilizer, and seed.
50–100 Mg ha^{-1} net acid†	Without lime	Topsoil cover with 50 cm or greater final depth. Use conventional lime, fertilizer, seed.
>100 Mg ha^{-1} net acid	Add lime (ABA need) at refuse-soil contact	30–50 cm of final topsoil depth. Use conventional lime, fertilizer, seed.

† On flat and gently sloping surfaces (<20%), lime and organic amendments may be applied in several treatments. Splitting lime applications, so as to allow it to react with the acidic refuse prior to seed application, may allow direct seeding on materials of up to 100 Mg ha^{-1} net ABA acidity. This will occur only on near-level to moderately sloped areas.

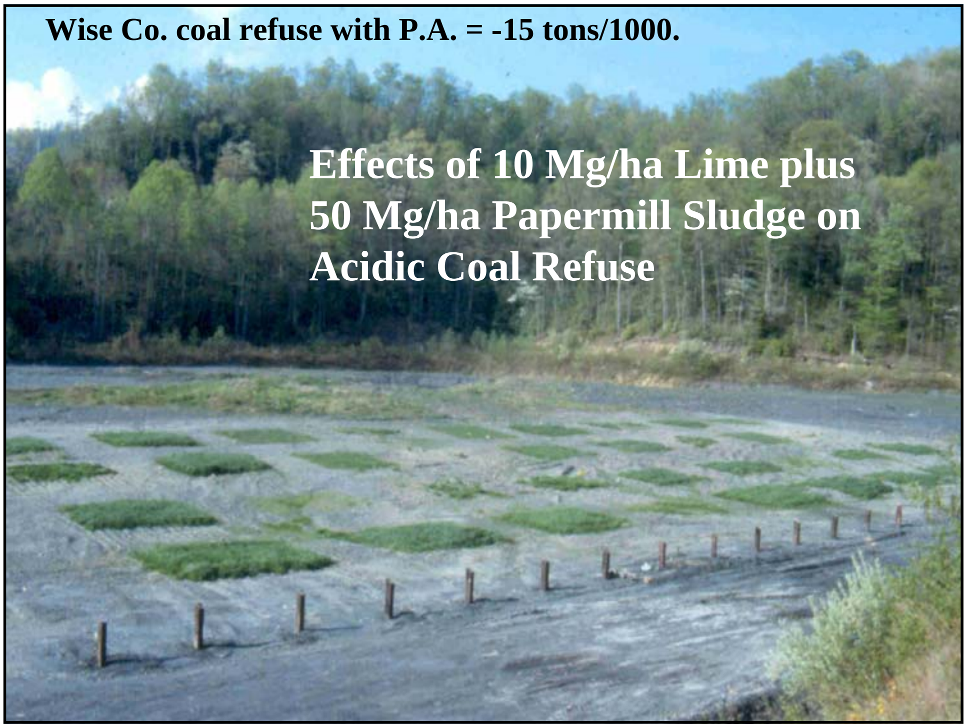
‡ These recommendations do not take sideslope seeps and springs into account. Such seeps are usually acidic; affected areas will need to be spot treated.

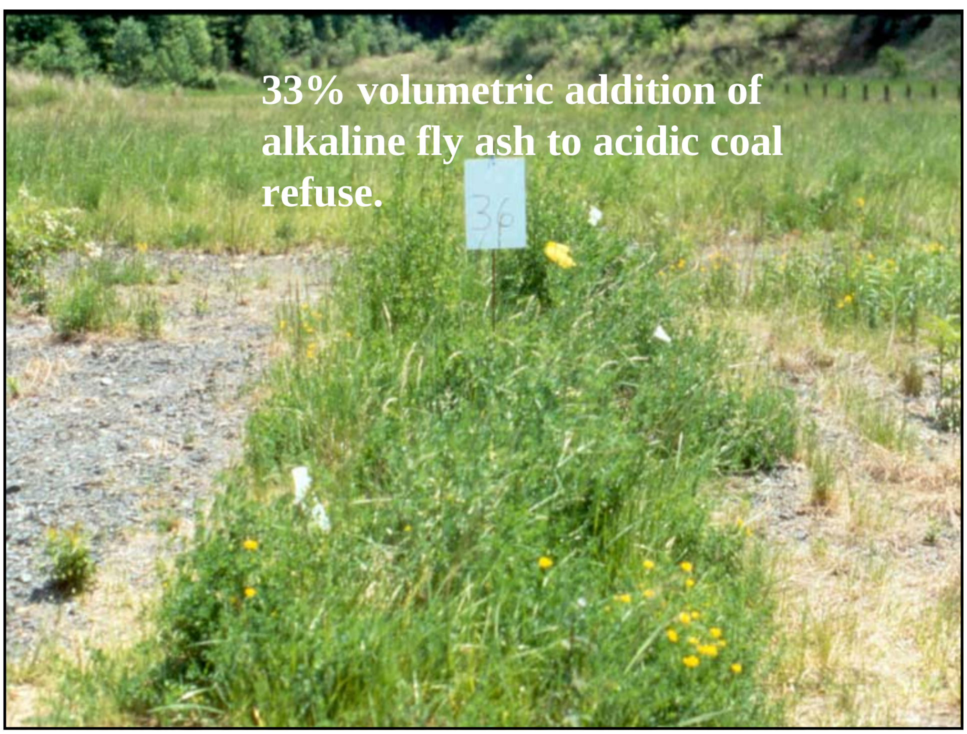
§ Organic amendment consisting of stabilized biosolids, papermill sludge, composted wood chips or similar material with C/N <30 at a rate of at least 50 Mg ha^{-1}, incorporated with a chisel plow.

Coal Waste Revegetation Criteria

Daniels et al., 2000, Agronomy Mono # 41

- **Where liming is practical (PA $\leq$ 50 Mg/ha and slopes < 25%), direct seeding is feasible with heavy P (400 kg/ha) and mulch applications, and via the use of acid/salt tolerant species like Festuca rubra, etc.**
- **Additional organic amendment with biosolids or composts is highly recommended at $\geq$ 100 Mg/ha, incorporated.**


Wise Co. coal refuse with P.A. = -15 tons/1000.
Effects of 10 Mg/ha Lime plus 50 Mg/ha Papermill Sludge on Acidic Coal Refuse


33% volumetric addition of alkaline fly ash to acidic coal refuse.
36

Conclusions

The long-term stabilization and revegetation of acid-forming coal refuse materials continues to be the single most challenging revegetation problem in the Appalachian coal fields.

Regardless of the long term implementation of SMCRA, most coal refuse disposal facilities do not have sufficient topsoil or topsoil substitute resources on hand to meet the mandated 1.2 m topsoil cover requirements. Therefore, reasonable and verifiable procedures for determining essential cover depths were required.

Conclusions

Implementation of the topsoil wedge design at three locations over a range of coal refuse acidity conditions generated a multi-year research data set for this purpose.

Conclusions

By coupling these data with a number of common-sense observational findings, we generated a viable and proven effective strategy for determining minimal topsoil thickness requirements for a range of coal refuse conditions.

Acknowledgements

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